State of California | The Resources Agency

Memorandum

Date : May 1, 1985

To : Arthur C. Gooch
Chief, Division of Planning

Bob Potter
Chief, Planning Branch

From : Department of Water Resources

Subject : State Water Project Service Area Impact Study

Attached is the Final Report of the State Water Project Service Area Impact Study (SAIS). The SAIS examines the socioeconomic and environmental effects of five hypothetical scenarios of State Water Project (SWP) deliveries upon the service areas and the State as a whole. These scenarios include one of full contractual entitlement deliveries (Scenario 1), three scenarios of intermediate deliveries (Scenarios 2, 3, and 4), and one scenario of no future additions to the SWP (Scenario 5).

Specific socioeconomic impacts examined include changes in income, employment, population, housing, and agricultural acreages. Environmental impacts include changes in land use, soils and geology, vegetation, wildlife, water quality, and air quality.

The SAIS was conducted to provide a consistent method of measuring service area impacts of proposed water projects. In addition, the SAIS provides a current socioeconomic and environmental data inventory of the service areas. Information from the SAIS has already been incorporated into past environmental impact reports (EIRs) prepared by the Department, and will be used in future EIRs, as well. The SAIS should also prove useful to the water planning process in general because the types of impacts presented in the report (income, jobs, population, air pollution, etc.) are important to all citizens of the State.

Completion of the State Water Project (SWP) will involve a number of possible separate actions stretched out over a period of years. Environmental impact reports will be prepared for each proposed addition. In applying this approach the question of attributing significant service area impacts to comparatively small increments of water supply creates difficult and complex analytical problems which must be repeated each time a new supply alternative is considered. In an economy having the size and diversity of the Southern California service area (about 12 million people), the dependence such an economy might have on the

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addition of a relatively small amount of water is difficult to rationalize. On the other hand, the accumulative impacts of all the individual proposals necessary to complete the project could be significant. Consequently, the decision was made to evaluate the effects of completing the SWP, in total, and attribute a portion of those impacts to individual units. This would be done on a proportionate water supply basis; that is, impacts would be allocated to an individual unit in the same proportion that its water supply was allocated to the incremental water supply of the completed project.

This approach has advantages: (1) the basis for analysis will have been established, thereby assuming consistency, regardless of the analysts involved or the facilities being proposed; and (2) over the long term, budget and manpower savings will be realized because the technical studies will have been completed and there should be no need to completely repeat the process for each proposal.

Although the relationship between water and economic activity is obvious and direct in the case of agriculture (so much water equals so much irrigated acreage which, in turn, results in so much employment and income), the factors affecting urban growth are complex. On a local basis, the provision or non-provision of water hookups can control growth. However, on a regional basis where there are no overall growth policies or controls, growth is the product of both demographic and socioeconomic influences. Some rationale had to be developed for assessing urban-related impacts--preferably in a manner as obvious and straight-forward as in agriculture. The approach used ties impacts to those industries that are water-dependent. It recognizes that certain sectors of the economy necessarily respond to the availability of water, while others do not. Not all population change and associated environmental impacts can be attributed to water.[1/]

1/ It is easy to get trapped in matters of definition and semantics when discussing water dependency. In the context of this report, the issue is not whether all living things are dependent on water. Nor is it a question of survival, or even of significant changes in the standard of living. It is a matter, however, of accommodation and choice. Certain portions of the population can adjust to changes in the availability of resources of all types. However, on the practical side, businesses have the option of leaving resource-deficient areas or choosing to do business elsewhere, if the cost of compensating for the deficiencies exceeds those of alternative locations. If California were a country, it would be the seventh largest country in the world economically. This is due, in large measure, to the development and availability of its resource. When this is no longer the case, or if there were a perception of uncertainty, choices will be made which affect economic activity and related population growth without water deficiencies necessarily having become "severe".

This appears to be reasonable when considering an individual's decisions to have or not have children, the various reasons people move, government migration policies and the effectiveness of those policies, and the State's highly industrialized base.

In at least one respect, the impacts shown in this report could be considered conservative. Excluding the construction and service sectors (which do not depend on water) from the analysis probably results in the employment and income effects associated with water deficiencies being underestimated. Conversely, the report does not fully account for compensating actions that could be taken during periods of shortage, at least in the short term. The significance of this consideration is subject to question, however, since this report is premised on the non-completion of the SWP causing a more permanent, long-term deficiency. Under such circumstances, it is assumed that industries already in the impacted region will be forced to re-evaluate expansion plans or perhaps relocate. In addition, water-dependent industries not now in the service areas would not be expected to locate there. In both cases, employment, income, and population levels would be less than otherwise expected.

Finally, this report focuses only upon the effects of water shortages within the SWP service areas and the resulting "ripple" effects from interconnected economic activities in other areas of the State. It is recognized that a portion of the growth foregone in the service areas would reoccur in other regions within California, as well as other areas of the country. However, to determine how much relocations would occur would require an evaluation of the comparative advantage of those other regions. Such an undertaking was beyond the scope of this study. But, if such an analysis had been made, some of those industries not locating in (or forced to move from) the service areas would likely have located in other areas of California, thereby reducing overall statewide impacts.

Attachment

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CONTENTS

Page

Chapter II. SOUTHERN CALIFORNIA SERVICE AREA (Continued)

Page

Appendixes

Figures

Page

Figures (Continued)

Tables

Page

Tables (Continued)

Page

Tables (Continued)

Page

Tables (Continued)

Tables (Continued)

CHAPTER I. INTRODUCTION

The State of California has signed contracts with 30 water agencies throughout the State that require the State Water Project (SWP) to deliver a maximum of 4.23 million acre-feet after 2020. At present, the annual SWP yield is about 2.3 million acre-feet, which (because of depletions) could be reduced to about 1.6 million acre-feet by about 2020. Thus, if the SWP is to meet its service area needs, the State must complete additional facilities.

The California Environmental Quality Act (CEQA) requires that, before these facilities can be built, environmental impact reports (EIRs) must be prepared to document their socioeconomic and environmental effects, both at their sites and in the service areas they will serve. This report focuses solely on SWP service areas.

Purpose of the Study

The State Water Project Service Area Impact Study (SAIS) assesses the socioeconomic and environmental effects of future SWP deliveries upon the following service areas: Southern California, San Joaquin Valley, Central Coastal, South Bay, and North Bay.[1/] The study also inventories current socioeconomic and environmental data for the service areas. Information developed by this study can then be incorporated into EIRs for proposed SWP facilities.

The SWP will affect the areas of origin, as well as the service areas. However, the SAIS is limited to assessing the impacts only in the service areas.

Scenario Analysis

The total annual water entitlement of 4.23 million acre-feet is divided among the SWP service areas, as follows:

North Bay	67,000
South Bay	188,000
Central Coastal	82,700[2/]
San Joaquin Valley	1,355,000
Southern California	2,497,500
Feather River	39,800
	4,230,000

1/ The Feather River SWP service area is not included because, as the area of origin, it is entitled to some Feather River supplies, with or without the SWP.

2/ The Central Coastal service area's entitlement has recently been reduced to 70,500 acre-feet.

This study examines the impact of five hypothetical scenarios of water delivery.

- Scenario 1 is essentially based on full delivery; it assumes that the entire 4.23 million acre-feet will be delivered after 2020.
- Scenario 2 assumes that only 3.6 million acre-feet will be delivered after 2020.
- Scenario 3 assumes further reduction in entitlement delivery to 3.0 million acre-feet after 2020.
- Scenario 4 assumes that the current yield of the SWP (2.3 million acre-feet) is maintained through 2020. Because of anticipated future depletions to the SWP, Scenario 4 assumes some new facilities will be added to maintain current yield.
- Scenario 5 assumes a SWP yield of only about 1.6 million acre-feet by 2020. This is the "no project" alternative in which no further additions to the SWP are made. In fact, between 1990 and 2020, depletions are expected because of area-of-origin usage and the implementation of the Coordinated Operating Agreement between the Department of Water Resources and the U.S. Bureau of Reclamation. These depletions would amount to about 700,000 acre-feet per year by 2020.

Each scenario is analyzed over five periods: 1980-1989; 1990-1999; 2000-2009; 2010-2019; and 2020 and beyond. The distribution of the project yield over these periods is shown in Table 1. (All tables referred to in this chapter appear at the end of the chapter.)

The SWP contracts provide for two types of shortages: temporary and permanent. Scenarios 2 through 5 assume various levels of permanent shortage. Article 18b of the contracts specifies how the reduced yields are to be distributed to the contractors, should a permanent shortage develop.[3/] Table 2 shows how the yields of Scenarios 2 through 5 have been allocated to the service areas in accordance with this provision.

3/ Article 18b states, in part: "The annual entitlements and the maximum annual entitlements of all contractors, except to the extent such entitlements may reflect established rights under the area of origin statutes, shall, by amendment of Table A of this contract, be reduced proportionately by the State to the extent necessary so that the sum of the revised maximum annual entitlements of all contractors will then equal such reduced minimum project yield."

SWP deliveries to the Southern California, Central Coastal, South Bay, and North Bay service areas will be used primarily for municipal and industrial (M&I) purposes. Deliveries to the San Joaquin Valley service area will be used primarily for agriculture, although there will be M&I usage. Table 3 shows the distribution of the San Joaquin Valley scenario entitlements by M&I and agricultural uses. Agricultural deliveries make up about 90 percent of the 2020 deliveries to the service area and about 29 percent of total 2020 SWP deliveries.

Entitlement Requests vs. Delivery Capability

The five scenarios assume various hypothetical levels of SWP firm yield. Firm yield is the level of water deliveries that could be sustained through a sequence of dry years (for example, 1928-34) without temporary deficiencies in agricultural supplies in excess of those allowed by the SWP contracts.

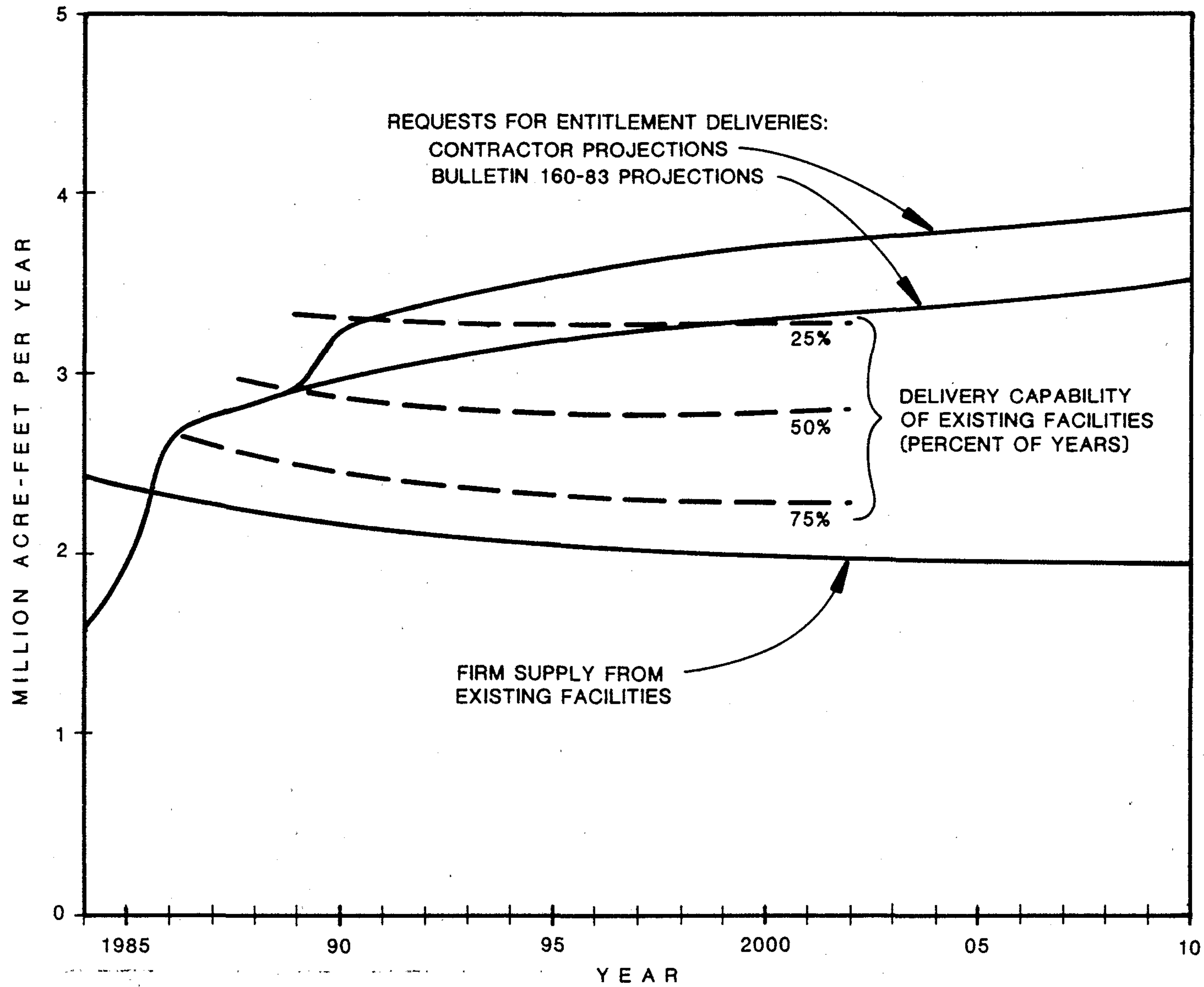
The maximum impact between scenarios is the numerical difference in income, employment, population, etc., between scenarios. For example, consider Scenarios 1 and 5. Scenario 1 assumes that full SWP supplies are delivered, whereas Scenario 5 assumes that future upstream depletions will ultimately reduce the firm yield of the existing facilities of the SWP to about 1.6 million acre-feet. Thus, the maximum impact of not completing the SWP is the numerical difference between these two scenarios.

However, except in critically dry years, deliveries by existing SWP facilities (Scenario 5) can exceed firm yield. When this occurs, the impact of not completing the SWP is less than the numerical difference between Scenarios 1 and 5 because more water is actually being delivered in Scenario 5 than is indicated by firm yield. The question is: how often and to what extent will actual Scenario 5 deliveries exceed the Scenario 5 firm yield entitlement?

Figure 1 shows the relationship between the gradually declining delivery capability of existing SWP facilities (Scenario 5) and the projected increasing water demands.[4/] The dashed lines show the estimated water delivery capabilities based on water availability associated with various levels of probability; for example, in half the years, the existing facilities could deliver at least the amount shown by the 50 percent line. These capabilities are shown in the following tabulation.

4/ See Figure 9 in: Department of Water Resources, Management of the California State Water Project, Bulletin 132-84, September 1984.

Figure 1. ENTITLEMENT REQUESTS VS. DELIVERY CAPABILITY



Source: Department of Water Resources, Bulletin 132-84: Management of the California State Water Project, September 1984.

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Delivery Capability of Existing Facilities Based on Water Availability

In million acre-feet

Probability	1990	1995	2000
Firm supply (more than 90% of years)	2.3	2.1	2.0
75% of years	2.5	2.3	2.3
50% of years	2.8	2.7	2.7
25% of years	3.4	3.3	3.3

In 1990, the firm supply of the existing facilities is about 2.3 million acre-feet. However, for 75 percent of the time, the existing SWP facilities could reliably deliver about 2.5 million acre-feet; for 50 percent of the time, 2.8 million acre-feet; and for 25 percent of the time, 3.4 million acre-feet. Similar increased delivery capabilities in years of normal or above-normal precipitation could occur at the 1995 and 2000 levels of development.

Although the maximum impact between Scenarios 1 and 5 is the numerical difference between the two scenarios, it is apparent that this maximum impact will occur infrequently because the existing SWP facilities have the probability of being able to deliver more water a large percentage of the time.

This study presents the impacts of meeting (or not meeting) the firm yield deliveries assumed in the five scenarios, including the total impact between Scenarios 1 and 5. However, the total impact should be considered as the maximum impact that has less than a 25 percent probability of occurring, if no additions were made to the SWP.

In contrast, for 75 percent of the time, the existing SWP facilities can deliver additional water equal to the deliveries assumed in Scenario 4. Thus, there is a 75 percent probability that the actual impact of reducing firm yield from Scenario 1 to Scenario 5 will be more similar to the differences between Scenarios 1 and 4.

For example, in a table presented later in this report (Table 4), the average annual direct, indirect, and induced statewide income impact between Scenarios 1 and 5 by 2000 will be about $19.9 billion (in 1982 dollars). This should be considered as a maximum impact that has less than a 25 percent probability of occurring, if no additions were made to the SWP. However, during the same period, there is a 75 percent probability that the actual impact will be less than $13.8 billion (this is the difference between Scenarios 1 and 4).

Thus, although the maximum impact between Scenarios 1 and 5 is the numerical difference between the two scenarios, it is apparent that this maximum impact will occur infrequently -- in less than 25 percent of the years.

All the Scenario 5 (no project) impacts presented later in this report were estimated before this probability information was available. Hence, these impacts are not described in terms of probabilities of occurrence. However, the probabilities discussed in this section are important, and they should be applied to all the Scenario 5 impacts.

Impact Definitions

Impacts are the differences among the socioeconomic and environmental compositions of the service areas, with and without full deliveries. The interpretation of these impacts is illustrated by Figure 2. The impact between Scenarios 1 and 2 is shown by distance a; between Scenarios 2 and 3, by b; between Scenarios 3 and 4, by c; and between Scenarios 4 and 5, by d. The total firm yield impact of reducing SWP deliveries from Scenario 1 to Scenario 5 (or of increasing deliveries from Scenario 5 to Scenario 1) is the sum of these increments, a + b + c + d[5/].

Of this total firm yield impact between Scenarios 1 and 5, it is possible to distinguish between socioeconomic growth that is foregone and the existing socioeconomic activity that is lost. Generally, Scenario 4 represents a continuation of current deliveries; thus, the incremental increases in SWP deliveries to Scenarios 3, 2, and 1 represent potential growth caused by water deliveries. Scenario 5 represents a decrease in SWP deliveries from current supplies caused by future depletions; if there were no further additions to the SWP, existing activity could be lost. Therefore, the total socioeconomic impact between Scenarios 1 and 5 includes growth potential (a + b + c), as well as a potential loss of existing activity (d).

Although Scenario 4 represents a continuation of current yield for the entire SWP, individual service areas may currently be above (or below) Scenario 4 deliveries. For example, the San Joaquin Valley service area is now receiving more water than it would with Scenario 4; thus there is less growth potential for this service area than is indicated by the quantitative difference between Scenarios 1 and 4. In contrast, the Central Coastal service area currently receives no SWP supplies; if this service area were to receive Scenario 4 deliveries, growth would then occur in reaching this scenario. Thus, the growth potential for

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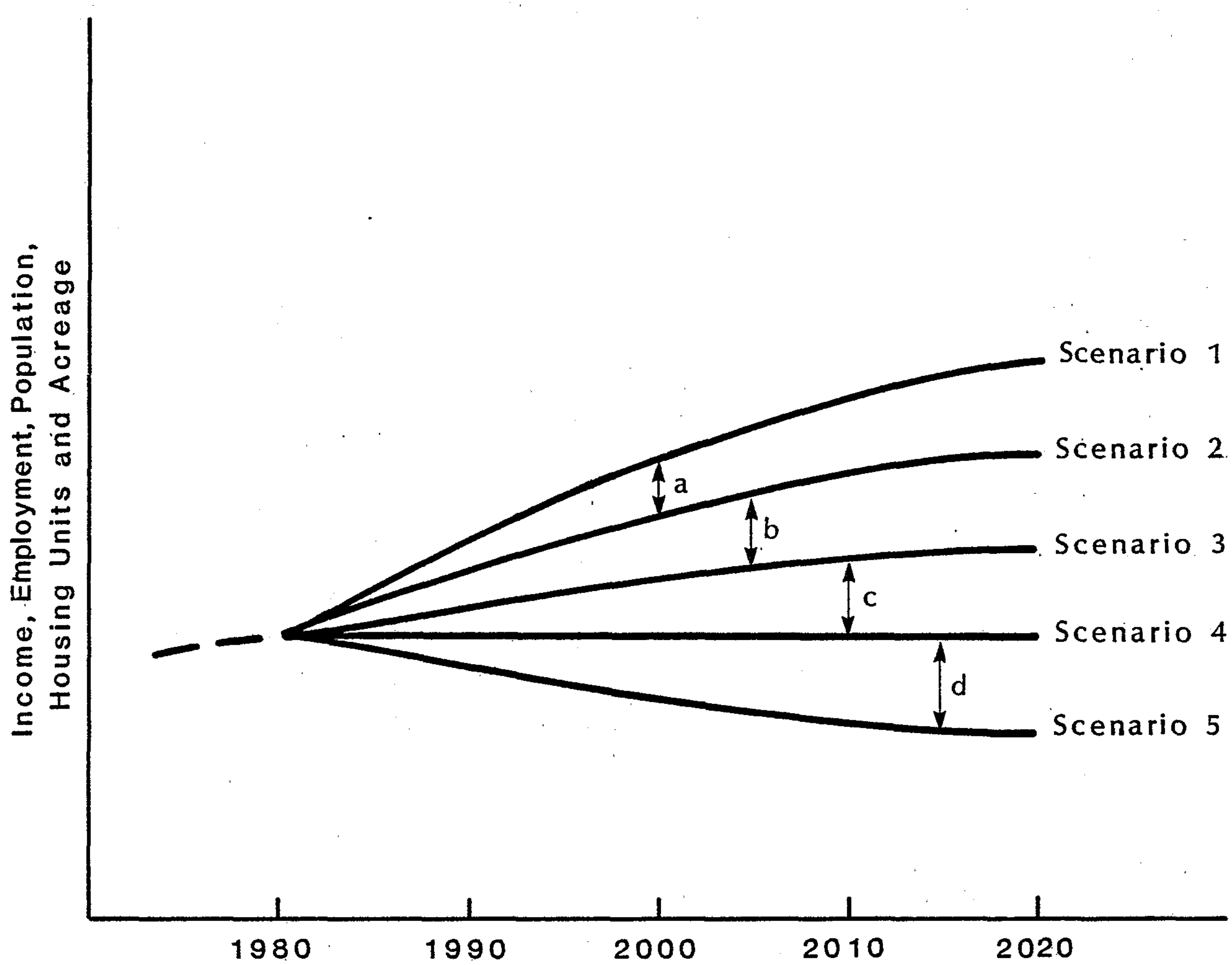
5/ Average yield impacts would be represented by the differences between Scenarios 1 and 3, or a + b.

Figure 2. ILLUSTRATION OF SOCIOECONOMIC AND ENVIRONMENTAL IMPACTS



this service area would be greater than the quantitative difference between Scenarios 1 and 4.

To account for differences between individual service areas, growth potential impacts are estimated by comparing historical average annual levels of socioeconomic activity associated with SWP deliveries (for the period 1979-1983) with impacts of Scenarios 1, 4, and 5. Comparisons of Scenario 1 impacts with the historical SWP activity will indicate total growth resulting from full SWP deliveries. Scenario 4 comparisons with historical SWP activity will indicate whether the service area will experience growth or lose activity, if the SWP were to remain at current yield. In contrast, Scenario 5 comparisons with historical SWP activity will indicate how much the service area will lose if the SWP does not add facilities. Growth potential impacts (which are estimated for population, housing, and land use) are calculated separately and presented in the environmental (land use) impacts sections.

The growth potential of SWP deliveries represented by <u>a</u>, <u>b</u>, and <u>c</u> in Figure 2 does not indicate additional levels of socioeconomic activity above official State and/or local agency forecasts. These forecasts generally assume that adequate levels of resources (including water) would be present to support the projections. Thus, the impact of completing the SWP is embodied in these projections.

However, if the SWP supplies were reduced from Scenario 1 to Scenarios 2 through 5, and if these reductions in SWP supplies were not compensated for by other actions (such as developing alternative water sources, increasing conservation above already-projected levels, or changing production technologies), then the differences between the scenarios could be viewed as reductions in the overall forecasts. For example, if the difference between Scenarios 1 and 5 is 100,000 for a population of a certain service area for a certain period of time, and local agency projections had estimated a total population of 800,000 during the same period for that area (assuming full supplies), then the estimate of 700,000 people could be used as an indicator of the reduced population levels with reduced SWP supplies, <u>if no other compensating actions were taken</u>. However, this reduction in population should be considered as a maximum impact, because other compensating actions could likely (to some degree) be taken, thereby reducing the impact.

The growth potential in the Southern California service area will need to be adjusted to account for the loss of Colorado River supplies. Annual Colorado River entitlements to The Metropolitan Water District of Southern California are being reduced from 1.2 million acre-feet to about 0.5 million acre-feet in the late 1980s. This will occur because of Supreme Court decisions to divert these supplies to the Central Arizona Project and increase the water rights of the lower Colorado River Indian tribes. However, of this 0.7 million acre-feet of entitlement that will be lost, only about 360,000 acre-feet are currently being used. Therefore, about 360,000 acre-feet of future SWP deliveries to this service area will be needed just to replace the portion of the Colorado River entitlement allotted to others. In this instance, SWP firm supplies will be replacing current supplies; thus the amount of socioeconomic activity associated with the firm supplies should be considered as maintenance of existing activity, not as potential growth.

Also, about 80 percent of the city of Los Angeles' present water supply -- 467,000 acre-feet per year -- is obtained from the Owens Valley-Mono Lake area. This supply could be significantly reduced if the courts rule against the city in the litigation related to the export of water from Mono Lake and the Owens Valley. Should this occur, the city would have to increase the supply obtained from The Metropolitan Water District of Southern California. The impact estimates presented in this report have not been adjusted to reflect this potential eventuality.

In contrast, opportunities exist to salvage water within the Imperial Valley. A program of canal lining, reservoir regulation, irrigation management, seepage recovery systems, and on-farm tailwater recovery systems would permit substantial irrigation water savings. This program would allow the Imperial Irrigation District to reduce its Colorado River diversions, leaving more of the California's Colorado River entitlement available for diversion by The Metropolitan Water District through its Colorado River Aqueduct under its existing Boulder Canyon Project contract with the United States. However, this water is of a much poorer quality than SWP supplies because of its greater salt content. The impact estimates in this report have not been adjusted to reflect this potential additional water source.

All impacts are reported on an average annual basis per decade. They represent what would occur during an average year in a particular decade. These impacts do not represent decade totals, nor should they be multiplied by 10 to obtain decade totals.[6/] For example, if during the 1990s the average annual population impact were 350,000, then for any given year during that decade, this would be the population impact. This does not, however, mean that the population impact is 350,000 for the entire decade, nor does it mean that the total decade population impact is 3,500,000.

6/ Multiplying by 10 implies that each year the same water deliveries affect new socioeconomic activity. However, once the initial impact has been established, in the subsequent years of the decade, the water continues to support this level of activity.

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Specific definitions of the economic, social, and environmental impacts presented in this report follow. For a more detailed discussion of these impacts, as well as the methodology used to estimate them, see Appendixes A, "Municipal and Industrial Impacts: Theory and Methodology", and B, "Agricultural Impacts: Theory and Methodology."

Economic Impacts

Economic impacts are the economic consequences of a project or other action. They can be classified as either direct, indirect, or induced. Water deliveries will directly affect the agricultural and municipal and industrial (M&I) sectors by permitting increased water-related production, employment, and income (profit, wages, etc.). These direct effects occur in the SWP service areas where the water is used. In addition, a direct change in the service areas' economies indirectly affects the local and State economies (a "ripple" effect). This occurs when the directly-impacted industries increase input purchases from other industries. With the increased direct and indirect production activities caused by water deliveries, wages and other forms of income are injected into the local and State economies in the form of personal consumption expenditures. These are induced effects. Thus, the total economic impact includes the sum of the direct impacts in the service area, as well as the indirect and induced statewide impacts.

One of the economic impacts estimated in this report is income. Income impacts are the changes in all forms of personal income between Scenario 1 and Scenarios 2 through 5, including economic profit to a firm's owner, employee wages, and allowances for net interest, indirect business taxes, and capital consumption. Much of the income impact presented in this report results from employee wages, which compose almost 75 percent of the total income impact in some of the service areas.

Income impacts should not be confused with water supply benefits. Water supply benefits are valued according to the user's willingness to pay. In practice, this concept can be estimated by two procedures. The first involves adding the change in economic profit accruing to a firm's owner to the water supply cost to the user (the owner). Employee compensation is not included because, if the owner is unwilling to purchase the water (because the cost of the water exceeds expected profit), no production will occur and no wages will be paid. Water supply costs are included to measure the return to the project. The second procedure involves estimating the cost of acquiring water from an alternative source. If an alternative source costs less than the first procedure described (economic profit plus water costs), then alternative costs become the estimate of the water supply benefit because users would not be willing to pay more for the project's water.

The estimation of M&I direct economic impacts requires the isolation of that portion of water supplies which affects income. It is assumed that water deliveries only to the industrial sector will affect income because the water is used directly in "income-producing" activities such as processing or cooling. (Water delivered to the residential, commercial, or government sectors is in most cases not essential in those sectors.)

Because water use patterns, input mix, and market demand factors vary among regions and among industries, income impacts are calculated on an industry-by-industry basis for each service area. Water-intensive industries in each service area are identified by use of Bulletin 124-3, Water Use by Manufacturing Industries in California, May 1982, which is the basis for segregating types of water uses. It is assumed that only water used for actual production (such as processing or cooling) creates income directly.

Once the income-producing water uses are identified, the actual income impact per acre-foot for each service area is determined from water use and economic relationships. These relationships are obtained from the Department's input/output model, which is documented in Bulletin 210, Measuring Economic Impacts - The Application of Input-Output Analysis to California Water Resource Problems, March 1980.

Direct agricultural economic impacts are estimated with the Department's Central Valley Agricultural (CVAg) linear programming model, which was developed to forecast agricultural water demand for the Central Valley of California. The model's region of analysis is the Department's Detailed Analysis Unit (DAU), which in Kern and Kings Counties can encompass two or three water districts.

The CVAg model selects the optimal choice of inputs (including water) for the agricultural production process, based upon the assumption of maximum profit. The model analyzes the impacts of changing water availability and/or prices upon cropping patterns.

Indirect and induced income and employment impacts are estimated for both the M&I and agricultural sectors, using the I/O model. Acreage and ground water pumping impacts are also estimated for agriculture.

Social Impacts

While economic impacts provide aggregate indications of changes in the economic environment of a region, social impacts indicate changes in the social well-being of a region. Some social impacts can be quantified; others cannot. Quantifiable social impacts presented in this report include changes in population and housing units. Population impacts are derived from employment changes in the M&I and agricultural sectors. Housing unit impacts are then derived from the population impacts.

Environmental Impacts

The delivery of SWP supplies to the service areas will affect income and employment in water-related industries and agriculture. Economic opportunities (such as increased income and employment) provided by the water will support population and urban development, which in turn affect the environment. Specific environmental impacts included in this report are changes in land use, vegetation, wildlife, and water and air quality.

Summary of Major Findings

Economic Impacts

Tables 4 and 5 summarize the average annual direct, indirect, and induced income and employment impacts between scenarios for the M&I and agricultural sectors for all the service areas discussed in this report. The tables display the impacts, by the decade in which they occur, as the differences between scenarios (between Scenarios 1 and 2, 2 and 3, etc.). (Again, the impacts are average annual impacts, not decade totals). The difference in socioeconomic activity between Scenarios 1 and 5 represents the maximum impact that could occur during dry years.

During the 1980s, the firm yield annual direct income impact (Table 4) in the service areas between Scenarios 1 and 5 is about $400 million (in 1982 dollars). Statewide, the firm yield annual direct, indirect, and induced income impacts total about $1.3 billion. By 2020, the annual direct income impact of total firm yield between Scenarios 1 and 5 has increased to about $14.4 billion, and the statewide direct, indirect, and induced income impact is about $49.0 billion. Thus, during dry years, the State could lose up to $49.0 billion per year, after 2020, if the SWP is not expanded to meet full entitlements. Through the years of this analysis, most of the income impacts occur in the M&I sector.

The significance of these income impacts can be determined by comparing them with projections for the entire State. For example, personal income in California in 1990 is expected to total about $460.5 billion (in 1982 dollars).[7/] By 1990, the average annual reduction in income (direct, indirect, and induced) between Scenarios 1 and 5 is about $10.6 billion, or about 2.3 percent of the State's total.

Direct employment impacts between Scenarios 1 and 5 (Table 5) during the 1980s average about 11,900 person-years per year, while the average annual statewide direct, indirect, and induced employment impacts total about 54,600 person-years.

7/ Center for the Continuing Study of the California Economy, California Growth in the 1980s; County Projections, 1982.

Employment impacts increase substantially by 2020, when the average annual direct impact reaches about 390,000 person-years. The direct, indirect, and induced employment impact totals about 2,273,800 person-years per year. As with the income impacts, most of the employment originates in the M&I sector.

The income and employment impacts discussed above occur in the M&I and agricultural sectors in all five service areas. However, other economic impacts are associated only with the agricultural sector in the San Joaquin Valley: contractor acreage and ground water pumping impacts.

Projected contractors' acreages by scenario and major crop types are shown in Table 6. With Scenario 1, the contractors' total acreages are projected to increase from 758,800 acres per year during the 1980s to about 858,400 acres per year after 2020. The largest crop type is field crops (primarily cotton), composing about 66 percent of the total crop acreages after 2010. In Scenarios 2 through 5, field crops tend to decline, a trend that is partially offset by increased grain and hay acreages.

Changes in SWP contractors' total acreages due to varying SWP deliveries are shown in Table 7. During the 1980s, total contractors' acreages between Scenarios 1 and 5 are reduced about 37,500 acres. By 2020, the total acreage impact between Scenarios 1 and 5 is about 20,700 acres.8/ In the 1990s and between 2010 and 2019, Scenario 4 acreages (with reduced SWP deliveries) actually exceed those of Scenario 1 (with full SWP entitlement). This occurs because the contractors will reduce field crop acreages, but this reduction is more than offset by the substitution of low water-using grain and hay crops. Also, to the extent economically and physically possible, the contractors will substitute ground water supplies for the reduced SWP deliveries.

Table 8 illustrates the increase in ground water pumping (above current levels) which occurs in the San Joaquin Valley service area as the SWP deliveries are reduced through the five scenarios. In the 1980s, pumping increases between Scenarios 1 and 5 by about 420,000 acre-feet. Increases continue through 2000 and then decline somewhat to about 444,900 acre-feet per year by 2020.

Such increases in ground water pumping would have additional socioeconomic impacts in the service area. Ground water levels would decline more rapidly, which would cause wells to be deepened and pumping equipment to be extended. As this occurs, more energy for pumping would be required, thereby increasing pumping costs. Eventually, higher pumping costs could cause land

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8/ If SWP surplus deliveries accompany SWP full entitlement deliveries after 1990 in this service area, the socioeconomic impacts will be greater.

to be removed from production, which would result in a further loss to the economy. Furthermore, land subsidence would continue and community costs would be incurred to repair the damage to surface facilities.

It is questionable whether this additional pumping could be sustained for long in a ground water basin that is already in overdraft. To test the impact of ground water availability that is restricted by economic, physical, or legal limitations, Scenario 5 was re-evaluated, using the same Scenario 5 SWP deliveries, but with reduced ground water. The restricted availability of ground water (RGW) is shown in Tables 4, 5, 7, and 8 as "Scenarios 1-5 (RGW)". Restricted ground water was not evaluated for the 1980s.

The combination of limited additional ground water pumping and reduced SWP deliveries (Scenario 5, RGW) has a significant effect upon the San Joaquin Valley. With these conditions, contractors' total acreages in 2020 decrease an additional 41,800 acres, to a total of 62,500 acres (Table 7). In addition, the direct agricultural 2020 income impact (Table 4) between Scenarios 1 and 5 (RGW) increases to $400 million (from $100 million), and the statewide direct, indirect, and induced income impact increases to about $1 billion (from $300 million). Employment (Table 5) will be similarly affected.

Social Impacts

Average annual population impacts between scenarios are shown in Table 9. During the 1980s, the firm yield population difference between Scenarios 1 and 5 is about 9,000 persons. By 2020, the difference between Scenarios 1 and 5 is about 3,551,900 persons.

Total California population is projected to be about 28.0 million persons in 1990.[9/] The total impact between Scenarios 1 and 5 for 1990 is about 703,200 persons, or about 2.5 percent of the total State population.

Housing unit impacts, shown in Table 10, accompany population changes. Average annual firm yield housing unit impacts between Scenarios 1 and 5 during the 1980s is about 3,800 units. By 2020, the annual impact for these two scenarios is about 1,451,500 units. Differences between single and multiple family units are also shown in the table.

The impact of increased water supplies upon social services in the service areas will be mixed. As indicated by this report, greater water supplies will likely raise income and

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9/ Center for the Continuing Study of the California Economy, California Growth in the 1980s: County Projections, 1982.

employment, both at the State and local levels. The increase in economic activity could benefit State revenues through higher income taxes and sales taxes, and a small portion of this could eventually reach local agencies as subventions. More important, local agencies could receive revenue directly from property tax proceeds, which would likely increase if population and housing were to expand.

However, additional socioeconomic activity can also strain local agencies because they have to furnish more services for this population (police and fire protection, schools, sewers, and streets). Many communities have found growth to be a mixed blessing because the costs of providing services have frequently outstripped revenues.

Environmental Impacts

The delivery of SWP supplies to the five service areas will affect income and employment in water-related industries. Economic opportunities (such as increased income and employment) will support population growth and urban development, which in turn affect the environment. Projected SWP contractor-irrigated acreage, population, housing unit, and acreage growth impacts in the five SWP service areas are summarized in Tables 11 and 13. Impacts are displayed by the decade in which they occur and show the incremental changes in total historical SWP activity (Column 1) caused by SWP deliveries by scenario for each decade. In comparing the growth associated with future SWP entitlement deliveries, allowances were made for impacts with and without replacement of the Colorado River entitlement after 1990 in the Southern California service area. Historical SWP socioeconomic activity and growth can be compared with the average annual total levels of socioeconomic activity and growth projected in the five SWP service areas (Table 15).

For example, it is estimated that, during the period 1979-1983, the SWP affected an average annual population of 1,947,300 in all five service areas (Table 11). During the 1980s, Scenario 1 deliveries will impact an estimated 759,200 more persons above the historical SWP average, or about 27.9 percent of the total projected population increase for all five service areas (Tables 12 and 14). During the 1990s, Scenario 1 deliveries, without adjusting for Colorado River replacement, will impact about 1,695,400 persons more than the historical SWP average and, between 2000 and 2009, about 2,135,800 persons more (Table 11). These impacts are about 35.1 and 31.4 percent of total projected population increases for all five service areas.

Table 11 also presents the increase in housing units and required acreages associated with this growth in housing. During the 1980s, Scenario 1 deliveries will impact an additional 286,800 housing units, requiring about 43,300 acres. These impacts are about 22.2 and 24.7 percent of the total projected increases for all five service areas. By 2010, 933,600 more housing units would be associated with full SWP deliveries. These housing units will require about 127,400 acres, or about 33 percent of the total projected increases for all five service areas.

After 1990, if portions of future SWP entitlement are used to replace Colorado River supplies, overall population growth above historic levels would occur under Scenario 1 in all time periods. During the 2000s, it is estimated that, after allowing for full replacement of Colorado River supplies, Scenario 1 SWP deliveries will impact an additional 1,333,000 persons above the historical SWP average (Table 13). This population will require about 606,000 housing units and about 80,000 acres. These impacts are about 19.6, 21.3, and 20.8 percent of the total projected increases for all five service area (Table 14).

Comparison of historical SWP averages with Scenario 4 indicates that, without any adjustments for Colorado River replacement, the five SWP service areas will grow, even if current yields were maintained (Table 11). Even if no additional facilities were added (Scenario 5), some growth is projected to occur, although at lower levels. After adjusting for replacement of Colorado River supplies lost after 1990, overall growth in the SWP service areas will occur (at lower levels) after 2000 under Scenarios 1 and 4. Under Scenario 5, increases in population will not occur in the SWP service areas after 2000.

The delivery and use of increased SWP water supplies will support future agricultural growth in the San Joaquin Valley service area and future urban growth in the North Bay, South Bay, San Joaquin Valley, Central Coastal, and Southern California service areas. Future urban development in the service areas depends upon securing additional water supplies. While SWP M&I water would support a portion of that development, if SWP supplies were not made available, alternative (possibly more expensive) sources could be developed for some areas. Secondary impacts resulting from urban growth will occur in the service areas, regardless of the source of additional water supplies. When these developments occur, appropriate mitigation actions would probably be included to prevent or offset adverse impacts on the environment, including rare and endangered species. Environmental analysis and mitigation for future urban development would result from the requirements of several environmental laws, including the California Coastal Act, the California Environmental Quality Act, the California Species Preservation Act, and the California Endangered Species Act.

Where SWP supplies replace existing supplies, no land use changes should take place. In counties where SWP-related growth could occur, actions to restrict new urban development in or near existing urban areas could minimize the adverse impacts of new development. Impacts will vary with local conditions and land use policies.

Increasing agricultural and urban growth will impact wildlife by increasing the number of acres of natural and native vegetation that would be urbanized or otherwise affected. The extent of this effect on wildlife will vary, but habitat and wildlife are expected to be lost directly as a result of urban growth. Indirect losses associated with urban growth will be the result of diversions of streams for municipal water supplies, increased effluent discharges, and intensified use of remaining open spaces. Some of these losses, such as those resulting from stream diversion, could be lessened if SWP water were used to replenish these streams directly or to replace these diversions, making more water available to wildlife.

Rare and endangered species may be affected, unless measures are adopted to avoid or mitigate those impacts. Urban growth in the SWP service areas will adversely impact these species, unless local planning agencies take steps to prevent urban encroachment into these critical habitats.

The adverse impacts of urban growth could be mitigated by the requirements of the California Environmental Quality Act. This act requires local agencies to identify harmful environmental effects of specific development proposals and to adopt feasible measures to avoid or mitigate these adverse effects before development occurs.

The State Water Resources Control Board and the Regional Water Quality Control Boards are responsible for regulating the activities and factors that may affect the quality of water of the State and to ensure attainment of the highest water quality that is reasonable, considering all present and future demands made on these waters and the beneficial uses involved. The regional boards in the service areas are responsible for preparing and maintaining regional Water Quality Control Plans. These plans are approved and periodically amended by the regional board, the State board, and the Environmental Protection Agency (EPA). Generally, these plans contain water quality objectives, adopted standards, and water quality data for the surface and ground water basins in the service area. The plans adopted for the service areas take into account delivery of increased water supplies, such as those from the SWP. Some negative water quality problems that might occur in the service areas could potentially be mitigated by the implementation of these plans.

Growth within all five service areas is expected to affect the regions' air quality, either decreasing air quality or making it more difficult to meet State and federal standards. Most regions will show slight increases of particulates, sulfur dioxide, and oxides of nitrogen. However, more stringent automobile emission standards will reduce oxidants and carbon monoxide emissions. With the implementation of more stringent measures to reduce air pollutants, most service areas (with the exception of the ozone standard in the South Coast Air Basin) are expected to reach attainment levels by or before 2000.

Table 1: Entitlement Scenarios - Overall State Water Project Yield
(thousands of acre-feet)

SWP Yield	Scenario	1980-1989	1990-1999	2000-2009	2010-2019	2020 +
4,230.0	1[1/]	2,359.5	3,112.9	3,416.2	3,878.5	4,230.0
3,600.0	2	2,359.5	3,112.9	3,416.2	3,600.0	3,600.0
3,000.0	3	2,359.5	3,000.0	3,000.0	3,000.0	3,000.0
2,300.0	4	2,300.0	2,300.0	2,300.0	2,300.0	2,300.0
1,600.0	5	2,300.0	2,100.0	2,000.0	1,700.0	1,600.0

1/ Based on Table B-5B, in The California State Water Project - Current Activities and Future Management Plans, Bulletin 132-81, Department of Water Resources, November 1981.

Table 2: Entitlement Scenarios - State Water Project Service Areas
(thousands of acre-feet)

SCENARIO 1

Service Area	1980-1989	1990-1999	2000-2009	2010-2019	2020 +
North Bay	10.3	29.1	36.5	45.9	67.0
South Bay	134.2	153.1	160.7	173.4	188.0
Central Coastal	0	34.5	52.5	58.6	70.5
San Joaquin Valley	1,041.5	1,340.6	1,338.5	1,345.3	1,355.0
Southern California	1,170.2	1,526.5	1,794.2	2,218.2	2,497.5
Feather River	3.3	29.1	33.8	37.1	39.8
Unallocated Surplus[1/]	0	0	0	0	12.2
Total	2,359.5	3,112.9	3,416.2	3,878.5	4,230.0

Table 2 (continued)

SCENARIO 2

Service Area	1980-1989	1990-1999	2000-2009	2010-2019	2020 +
North Bay	10.3	29.1	36.5	57.0	57.0
South Bay	134.2	153.1	160.7	160.3	160.2
Central Coastal	0	34.5	52.5	60.6	60.5
San Joaquin Valley	1,041.5	1,340.6	1,338.5	1,149.0	1,148.0
Southern California	1,170.2	1,526.5	1,794.2	2,125.3	2,123.8
Feather River	3.3	29.1	33.8	37.1	39.8
Unallocated Surplus 1/	0	0	0	10.7	10.7
Total	2,359.5	3,112.9	3,416.2	3,600.0	3,600.0

1/ Caused by reduction of Central Coastal's maximum entitlement from 82,700 to 70,500 acre-feet.

SCENARIO 3

Service Area	1980-1989	1990-1999	2000-2009	2010-2019	2020 +
North Bay	10.3	47.5	47.5	47.4	47.4
South Bay	134.2	133.7	133.5	133.3	133.2
Central Coastal	0	50.9	50.8	50.8	50.7
San Joaquin Valley	1,041.5	957.9	956.4	955.5	954.5
Southern California	1,170.2	1,772.4	1,769.5	1,767.4	1,765.9
Feather River	3.3	29.1	33.8	37.1	39.8
Unallocated Surplus 1/	0	8.5	8.5	8.5	8.5
Total	2,359.5	3,000.0	3,000.0	3,000.0	3,000.0

Table 2 (Continued)

SCENARIO 4

Service Area	1980-1989	1990-1999	2000-2009	2010-2019	2020 +
North Bay	36.7	36.3	36.3	36.2	36.2
South Bay	105.6	102.2	102.0	101.8	101.7
Central Coastal	0	45.4	45.3	45.3	45.2
San Joaquin Valley	756.8	732.3	730.9	729.7	728.9
Southern California	1,397.6	1,354.7	1,351.7	1,349.9	1,348.2
Feather River	3.3	29.1	33.8	37.1	39.8
Unallocated Surplus 1/	0	0	0	0	0
Total	2,300.0	2,300.0	2,300.0	2,300.0	2,300.0

SCENARIO 5

Service Area	1980-1989	1990-1999	2000-2009	2010-2019	2020 +
North Bay	36.7	33.1	31.5	26.6	25.0
South Bay	105.6	93.2	88.5	74.8	70.2
Central Coastal	0	41.4	39.3	33.3	31.2
San Joaquin Valley	756.8	668.7	634.6	536.7	503.5
Southern California	1,397.6	1,234.5	1,172.3	991.5	930.3
Feather River	3.3	29.1	33.8	37.1	39.8
Unallocated Surplus 1/	0	0	0	0	0
Total	2,300.0	2,100.0	2,000.0	1,700.0	1,600.0

Table 3: Agricultural and M&I Entitlements by Scenarios
San Joaquin Valley Service Area
(thousands of acre-feet)

Scenario	1980-1989	1990-1999	2000-2009	2010-2019	2020 +
Scenario 1					
Total Entitlement	1,041.5	1,340.6	1,338.5	1,345.3	1,355.0
Agriculture	943.1	1,212.6	1,210.7	1,216.8	1,226.3
M&I	98.4	128.0	127.8	128.5	128.7
Scenario 2					
Total Entitlement	1,041.5	1,340.6	1,338.5	1,149.0	1,148.0
Agriculture	943.1	1,212.6	1,210.7	1,038.8	1,038.2
M&I	98.4	128.0	127.8	110.2	109.8
Scenario 3					
Total Entitlement	1,041.5	957.9	956.4	955.5	954.5
Agriculture	943.1	866.3	864.9	864.1	863.1
M&I	98.4	91.6	91.5	91.4	91.4
Scenario 4					
Total Entitlement	756.8	732.3	730.9	729.7	728.9
Agriculture	684.3	662.3	661.0	659.9	659.1
M&I	72.5	70.0	69.9	69.8	69.8
Scenario 5					
Total Entitlement	756.8	668.7	634.6	536.7	503.5
Agriculture	684.3	604.2	573.4	485.1	454.9
M&I	72.5	64.5	61.2	51.6	48.6

M&I = municipal and industrial.

Table 4: Summary - Average Annual Direct, Indirect, and Induced Income Impacts Supported by SWP Firm Deliveries
(billions of 1982 dollars)

Impacts Between Scenarios	1980-1989						1990-1999					
	M&I		Agricultural		Total		M&I		Agricultural		Total	
	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced
Scenarios 1 and 2	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Scenarios 2 and 3	0	0	0	0	0	0	0.2	0.7	0	0	0.2	0.7
Scenarios 3 and 4	0.4	1.2	0	0.1	0.4	1.3	1.8	6.0	0	0.1	1.8	6.1
Scenarios 4 and 5	0	0	0	0	0	0	1.1	3.8	0	0	1.1	3.8
Scenarios 4 and 5 (RGW)	-	-	-	-	-	-	1.1	3.8	0	0.1	1.1	3.9
Total Impact												
Scenarios 1 and 5	0.4	1.2	0	0.1	0.4	1.3	3.1	10.5	0	0.1	3.1	10.6
Scenarios 1 and 5 (RGW)	-	-	-	-	-	-	3.1	10.5	0.1	0.2	3.2	10.7

	2000-2009					
	M&I		Agricultural		Total	
	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced
Scenarios 1 and 2	$0	$0	$0	$0	$0	$0
Scenarios 2 and 3	0.4	1.1	0	0.1	0.4	1.2
Scenarios 3 and 4	3.7	12.5	0	0.1	3.7	12.6
Scenarios 4 and 5	1.8	6.2	0	0	1.8	6.2
Scenarios 4 and 5 (RGW)	1.8	6.2	0.1	0.3	1.9	6.5
Total Impact						
Scenarios 1 and 5	5.9	19.8	0.1	0.1	6.0	19.9
Scenarios 1 and 5 (RGW)	5.9	19.8	0.2	0.4	6.1	20.2

(Table 4 continues on following page.)

Columns may not total due to rounding. Impacts represent what would occur during an average year per decade; they are not decade totals.

RGW = restricted ground water availability in the San Joaquin Valley Service Area.

C-095114

Table 4: Summary - Average Annual Direct, Indirect and Induced Income Impacts Supported by SWP Firm Deliveries (Continued)
(billions of 1982$)

Impacts Between Scenarios	2010-2019						2020+					
	M&I		Agricultural		Total		M&I		Agricultural		Total	
	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced
Scenarios 1 and 2	$ 1.0	$3.2	$0	$0	$1.0	$3.2	$3.6	$12.1	$0	$0.1	$3.6	$12.2
Scenarios 2 and 3	3.0	10.0	0	0.1	3.0	10.1	3.1	10.5	0	0.1	3.1	10.6
Scenarios 3 and 4	3.8	13.0	0	0.1	3.8	13.1	3.7	12.5	0	0.1	3.7	12.6
Scenarios 4 and 5	3.5	11.9	0	0.1	3.5	12.0	3.9	13.6	0	0.1	3.9	13.7
Scenarios 4 and 5 (RGW)	3.5	11.9	0.2	0.6	3.7	12.5	3.9	13.6	0.3	0.8	4.2	14.4
Total Impact												
Scenarios 1 and 5	11.3	38.1	0.1	0.3	11.4	38.4	14.3	48.7	0.1	0.3	14.4	49.0
Scenarios 1 and 5 (RGW)	11.3	38.1	0.3	0.8	11.6	38.9	14.3	48.7	0.4	1.0	14.7	49.7

Table 5: Summary - Average Annual Direct, Indirect, and Induced Employment Impacts Supported by SWP Firm Deliveries
(thousands of person-years)

Impacts Between Scenarios	1980-1989						1990-1999					
	M&I		Agricultural		Total		M&I		Agricultural		Total	
	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced
Scenarios 1 and 2	0	0	0	0	0	0	0	0	0	0	0	0
Scenarios 2 and 3	0	0	0	0	0	0	9.9	50.2	0	0	9.9	50.2
Scenarios 3 and 4	11.7	54.0	0.2	0.6	11.9	54.6	48.6	272.4	0	0	48.6	272.4
Scenarios 4 and 5	0	0	0	0	0	0	28.8	166.7	0.1	0.3	28.9	167.0
Scenarios 4 and 5 (RGW)	-	-	-	-	-	-	28.8	166.7	1.0	2.8	29.8	169.5
Total Impact												
Scenarios 1 and 5	11.7	54.0	0.2	0.6	11.9	54.6	87.3	489.3	0.1	0.3	87.4	489.6
Scenarios 1 and 5 (RGW)	-	-	-	-	-	-	87.3	489.3	1.0	2.8	88.3	492.1

Impacts Between Scenarios	2000-2009					
	M&I		Agricultural		Total	
	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced
Scenarios 1 and 2	0	0	0	0	0	0
Scenarios 2 and 3	17.9	93.2	0	0	17.9	93.2
Scenarios 3 and 4	101.8	591.0	0	0	101.8	591.0
Scenarios 4 and 5	45.7	267.9	0.1	0.3	45.8	268.2
Scenarios 4 and 5 (RGW)	45.7	267.9	2.1	6.0	47.8	273.9
Total Impact						
Scenarios 1 and 5	165.4	952.1	0.1	0.3	165.5	952.4
Scenarios 1 and 5 (RGW)	165.4	952.1	2.1	6.0	167.5	958.1

(Table 5 continues on following page.)

Impacts represent what would occur during an average year per decade; they are not decade totals.

RGW = restricted ground water.

Table 5: Summary - Average Annual Direct, Indirect, and Induced Employment Impacts Supported by SWP Firm Deliveries (Continued)
(thousands of person-years)

Impacts Between Scenarios	2010-2019						2020+					
	M&I		Agricultural		Total		M&I		Agricultural		Total	
	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced
Scenarios 1 and 2	25.8	147.4	0.4	1.1	26.2	148.5	92.9	543.3	0.4	1.1	93.3	544.4
Scenarios 2 and 3	87.4	507.9	0	0	87.4	507.9	89.3	522.0	0	0	89.3	522.0
Scenarios 3 and 4	102.8	602.0	0.1	0.3	102.9	602.3	103.2	602.7	0.1	0.3	103.3	603.0
Scenarios 4 and 5	89.8	522.8	0.2	0.6	90.0	523.4	103.8	603.5	0.3	0.9	104.1	604.4
Scenarios 4 and 5 (RGW)	89.8	522.8	2.9	8.4	92.7	531.2	103.8	603.5	3.6	10.2	107.4	613.7
Total Impact												
Scenarios 1 and 5	305.8	1,780.1	0.7	2.0	306.5	1,782.1	389.2	2,271.5	0.8	2.3	390.0	2,273.8
Scenarios 1 and 5 (RGW)	305.8	1,780.1	3.4	9.8	309.2	1,789.9	389.2	2,271.5	4.1	11.6	393.3	2,283.1

C-095117

Table 6: Projected SWP Contractors' Acreages
(thousands of acres)

Crop Type	1980-1989 Acres	%	1990-1999 Acres	%	2000-2009 Acres	%	2010-2019 Acres	%	2020 + Acres	%
Scenario 1										
Subtropical	9.1	1.2	10.1	1.3	10.4	1.3	11.6	1.4	12.0	1.4
Deciduous	51.6	6.8	50.7	6.5	51.3	5.4	53.2	6.4	54.9	6.4
Grain and Hay	50.1	6.6	83.4	10.7	84.3	10.5	78.9	9.5	81.5	9.5
Field	502.3	66.2	486.7	62.4	497.5	62.0	548.9	66.1	567.5	66.1
Truck	42.5	5.6	43.7	5.6	51.4	6.4	55.6	6.7	57.5	6.7
Pasture	74.4	9.8	75.7	9.7	72.2	9.0	51.5	6.2	53.2	6.2
Vineyards	28.8	3.8	29.6	3.8	35.3	5.4	30.7	3.7	31.8	3.7
Total	758.8	100.0	779.9	100.0	802.4	100.0	830.4	100.0	858.4	100.0
Scenario 2										
Subtropical	9.1	1.2	10.1	1.3	10.4	1.3	11.5	1.4	10.7	1.3
Deciduous	51.6	6.8	50.7	6.5	51.3	5.4	52.4	6.4	52.9	6.4
Grain and Hay	50.1	6.6	83.4	10.7	84.3	10.5	79.4	9.7	80.2	9.7
Field	502.3	66.2	486.7	62.4	497.5	62.0	537.4	65.7	543.9	65.8
Truck	42.5	5.6	43.7	5.6	51.4	6.4	54.8	6.7	54.5	6.6
Pasture	74.4	9.8	75.7	9.7	72.2	9.0	51.5	6.3	53.7	6.5
Vineyards	28.8	3.8	29.6	3.8	35.3	5.4	31.1	3.8	30.6	3.7
Total	758.8	100.0	779.9	100.0	802.4	100.0	818.1	100.0	826.5	100.0

Table 6: Projected SWP Contractors' Acreages (Continued)
(thousands of acres)

Crop Type	1980-1989 Acres	%	1990-1999 Acres	%	2000-2009 Acres	%	2010-2019 Acres	%	2020 + Acres	%
					Scenario 3					
Subtropical	9.1	1.2	10.1	1.3	9.3	1.2	10.9	1.3	10.9	1.3
Deciduous	51.6	6.8	51.3	6.6	51.3	5.5	53.5	6.4	53.8	6.4
Grain and Hay	50.1	6.6	88.6	11.4	87.3	11.2	89.5	10.7	90.0	10.7
Field	502.3	66.2	483.2	62.2	478.4	61.3	546.9	65.4	549.9	65.4
Truck	42.5	5.6	38.9	5.0	47.5	6.1	51.8	6.2	52.1	6.2
Pasture	74.4	9.8	74.6	9.6	70.9	9.1	51.8	6.2	52.1	6.2
Vineyards	28.8	3.8	30.3	3.9	34.4	5.5	31.8	3.8	31.9	3.8
Total	758.8	100.0	777.0	100.0	779.1	100.0	836.2	100.0	840.7	100.0
					Scenario 4					
Subtropical	8.7	1.2	10.2	1.3	10.3	1.3	11.6	1.4	11.7	1.4
Deciduous	50.6	7.0	51.6	6.6	51.3	5.5	53.2	6.4	53.7	6.4
Grain and Hay	45.6	6.3	100.9	12.9	99.4	12.6	98.9	11.9	99.9	11.9
Field	477.3	66.0	475.1	60.7	476.1	60.4	534.2	64.3	539.6	64.3
Truck	39.8	5.5	38.3	4.9	45.0	5.7	49.9	6.0	50.3	6.0
Pasture	73.0	10.1	75.9	9.7	71.8	9.1	51.5	6.2	52.0	6.2
Vineyards	28.2	3.9	30.5	3.9	34.7	5.4	31.6	3.8	31.9	3.8
Total	723.2	100.0	782.5	100.0	788.6	100.0	830.9	100.0	839.1	100.0

Table 6: Projected SWP Contractors' Acreages (Continued)
(thousands of acres)

Crop Type	1980-1989 Acres	%	1990-1999 Acres	%	2000-2009 Acres	%	2010-2019 Acres	%	2020 + Acres	%
Scenario 5										
Subtropical	8.7	1.2	10.1	1.3	10.2	1.3	11.7	1.4	11.7	1.4
Deciduous	50.5	7.0	51.9	6.7	51.3	5.5	53.3	6.4	53.6	6.4
Grain and Hay	45.4	6.3	100.6	13.0	103.1	13.1	107.5	12.9	108.9	13.0
Field	476.0	66.0	467.4	60.4	470.7	59.8	527.3	63.3	527.8	63.0
Truck	39.7	5.5	37.9	4.9	44.9	5.7	50.0	6.0	50.3	6.0
Pasture	72.9	10.1	75.8	9.8	71.6	9.1	51.7	6.2	51.9	6.2
Vineyards	28.1	3.9	30.2	3.9	35.3	5.5	31.7	3.8	33.5	4.0
Total	721.3	100.0	773.9	100.0	787.1	100.0	833.2	100.0	837.7	100.0
Scenario 5 (RGW)										
Subtropical	--	--	10.0	1.3	10.7	1.4	9.5	1.2	9.6	1.2
Deciduous	--	--	50.8	6.6	50.0	5.5	49.9	6.3	50.1	6.3
Grain and Hay	--	--	119.4	15.5	140.4	18.4	166.2	21.0	181.5	22.8
Field	--	--	440.9	57.2	404.3	53.0	427.3	54.0	416.2	52.3
Truck	--	--	44.7	5.8	52.6	6.9	60.9	7.7	61.3	7.7
Pasture	--	--	74.7	9.7	70.9	9.3	46.7	5.9	46.2	5.8
Vineyards	--	--	30.0	3.9	34.0	5.5	30.9	3.9	31.0	3.9
Total	--	--	770.5	100.0	762.9	100.0	791.4	100.0	795.9	100.0

Table 7: Summary - Average Annual Contractors' Acreage Impact with SWP Firm Deliveries, San Joaquin Valley Service Area (thousands of acres)

Impacts Between Scenarios	1980 1989	1990- 1999	2000- 2009	2010- 2019	2020+
Scenarios 1 and 2	0	0	0	12.3	31.9
Scenarios 2 and 3	0	2.9	23.3	[18.1]	[14.2]
Scenarios 3 and 4	35.6	[5.5]	[9.5]	5.3	1.6
Scenarios 4 and 5	1.9	8.6	1.5	[2.3]	1.4
Scenarios 4 and 5 (RGW)	- 1/	12.1	25.7	39.5	43.2
Total Impact					
Scenarios 1 and 5	37.5	6.0	15.3	[2.8]	20.7
Scenarios 1 and 5 (RGW)	- 1/	9.5	39.5	39.0	62.5

Brackets indicate acreage increases, caused by an increase in acreage planted in low water-using grain and hay crops.

1/ Restricted ground water (RGW) scenario not estimated for 1980-1989.

Table 8: Increased Ground Water Pumping,
San Joaquin Valley Service Area
(thousands of acre-feet)

Impacts Between Scenarios	1980-1989	1990-1999	2000-2009	2010-2019	2020+
Scenarios 1 and 2	0	0	0	95.8	94.2
Scenarios 2 and 3	0	323.5	330.5	180.1	168.4
Scenarios 3 and 4	420.0	148.2	(29.1) 1/	151.8	164.2
Scenarios 4 and 5	0	9.1	186.0	12.7	18.1
Total Impact					
Scenarios 1-5	420.0	480.8	487.4	440.4	444.9
Scenarios 1-5 (RGW)	-	409.6	313.0	145.3	112.7

Impacts represent what would occur during an average year per decade; they are not decade totals.

1/ Parentheses indicate a decrease in ground water pumping between scenarios.

Table 9: Summary - Average Annual Population Impacts Supported by
SWP Firm Deliveries
(thousands of persons)

Impacts Between Scenarios	1980-1989	1990-1999	2000-2009	2010-2019	2020+
Scenarios 1 and 2	0	0	0	212.4	847.6
Scenarios 2 and 3	0	0	66.5	809.8	812.0
Scenarios 3 and 4	9.0	419.7	943.2	944.1	944.7
Scenarios 4 and 5	0	283.5	410.2	813.5	947.6
Total Impact	9.0	703.2	1,419.9	2,779.8	3,551.9

Impacts represent what would occur during an average year per decade; they are not decade totals.

Table 10: Summary - Average Annual Housing Unit Impact Supported by SWP Firm Deliveries
(thousands of units)

Impacts Between Scenarios	1980-1989 Total	1980-1989 Single Family	1980-1989 Multiple Family	1990-1999 Total	1990-1999 Single Family	1990-1999 Multiple Family	2000-2009 Total	2000-2009 Single Family	2000-2009 Multiple Family
Scenarios 1 and 2	0	0	0	0	0	0	0	0	0
Scenarios 2 and 3	0	0	0	4.1	3.2	0.9	27.7	17.2	10.5
Scenarios 3 and 4	3.8	3.0	0.8	168.4	102.4	66.0	385.3	225.2	160.1
Scenarios 4 and 5	0	0	0	116.2	70.5	45.7	167.7	98.1	69.6
Total Impact	3.8	3.0	0.8	288.7	176.1	112.6	580.7	340.5	240.2

Impacts Between Scenarios	2010-2019 Total	2010-2019 Single Family	2010-2019 Multiple Family	2020+ Total	2020+ Single Family	2020+ Multiple Family
Scenarios 1 and 2	87.0	51.2	35.8	346.4	202.6	143.8
Scenarios 2 and 3	330.9	193.5	137.4	331.9	194.2	137.7
Scenarios 3 and 4	385.7	225.5	160.2	386.0	225.6	160.4
Scenarios 4 and 5	332.6	194.6	138.0	387.2	226.7	160.5
Total Impact	1,136.2	664.8	471.4	1,451.5	849.1	602.4

Impacts represent what would occur during an average year per decade; they are not decade totals.

Table 11: Summary - SWP Impacts Above Historical Activity, Without Colorado River Replacement[1/]

	1979-1983 [2/] SWP Annual Average	1980-1989			1990-1999			2000-2009		
		Scenario 1	Scenario 4	Scenario 5	Scenario 1	Scenario 4	Scenario 5	Scenario 1	Scenario 4	Scenario 5
Contractor-Irrigated Acreage (thousands of acres)	740.9	17.9	(17.7)	(19.6)	39.0	41.6	33.0	61.5	47.7	46.2
Population (thousands of persons)	1,947.3	759.2	750.2	750.2	1,695.4	1,275.7	991.2	2,135.8	1,125.9	715.8
Housing Units (thousands of units)										
Single Family	455.6	177.3	174.3	174.3	451.6	345.8	275.5	521.7	279.1	181.2
Multiple Family	280.1	109.5	108.7	108.7	308.1	238.2	195.5	411.9	241.3	171.7
TOTAL	735.7	286.8	283.0	283.0	759.7	584.0	471.0	933.6	520.4	352.9
Acreage Requirements (thousands of acres)										
Single Family[3/]	91.1	35.4	34.8	34.8	90.3	69.1	55.1	104.3	55.8	36.3
Multiple Family[4/]	14.0	7.9	7.9	7.9	17.9	14.5	12.3	23.1	14.5	11.1
TOTAL	105.1	43.3	42.7	42.7	108.2	83.6	67.4	127.4	70.3	47.4

1/ These impacts are the incremental changes in historical SWP activity caused by SWP scenario deliveries for each decade. Positive numbers represent an incremental increase in SWP historical activity (growth), while negative numbers (in parentheses) represent incremental decreases in SWP historical activity.

2/ These estimates are the total levels of socioeconomic activity affected by SWP average annual deliveries over the period 1979-1983.

3/ Assumes 1 acre could accommodate 5 single family units.

4/ Assumes 1 acre could accommodate 20 multiple family units.

Table 12: Summary - SWP Impacts As Percentage of Total Projected Service Area Increase,[1/]
Without Colorado River Replacement

	1980-1989			1990-1999			2000-2009		
	Scenario 1	Scenario 4	Scenario 5	Scenario 1	Scenario 4	Scenario 5	Scenario 1	Scenario 4	Scenario 5
Contractor-Irrigated Acreage	45.9%	(45.4%)	(50.3%)	63.4%	67.6%	53.7%	68.7%	53.3%	51.6%
Population	27.9%	27.6%	27.6%	35.1%	26.4%	20.5%	31.4%	16.5%	10.5%
Housing Units									
Single Family	24.1%	23.7%	23.7%	37.8%	30.0%	23.1%	32.4%	17.3%	11.3%
Multiple Family	19.6	19.5	19.5	34.5	26.7	21.9	33.3	19.5	13.9
OVERALL HOUSING	22.2	21.9	21.9	36.4	28.0	22.6	32.8	18.3	12.4
Acreage Requirements									
Single Family	24.1%	23.7%	23.7%	34.0%	26.0%	20.7%	32.4%	17.3%	11.3%
Multiple Family	28.1	28.1	28.1	29.4	23.8	20.2	37.4	23.5	18.0
OVERALL ACREAGE	24.7	24.4	24.4	33.1	25.6	20.6	33.2	18.3	12.4

1/ This compares the incremental percentage change in socioeconomic activity caused by SWP deliveries with the total incremental change projected in Table 15. Positive numbers represent an incremental percentage increase in SWP historical activity (growth), while negative numbers (in parentheses) represent incremental percentage decreases in SWP historical activity.

C-095125

Table 13: Summary - SWP Impacts Above Historical Activity, With Colorado River Replacement 1/

	1979-1983 2/ SWP Annual Average	1980-1989			1990-1999			2000-2009		
		Scenario 1	Scenario 4	Scenario 5	Scenario 1	Scenario 4	Scenario 5	Scenario 1	Scenario 4	Scenario 5
Contractor-Irrigated Acreage (thousands of acres)	740.9	17.9	(17.7)	(19.6)	39.0	41.6	33.0	61.5	47.7	46.2
Population (thousands of persons)	1,947.3	759.2	750.2	750.2	853.0	433.5	148.8	1,333.0	323.1	(87.0)
Housing Units										
(thousands of units)										
Single Family	455.6	177.3	174.3	174.3	242.8	137.0	66.7	330.9	88.3	(9.6)
Multiple Family	280.1	109.5	108.7	108.7	171.3	101.4	58.7	275.1	104.5	34.9
TOTAL	735.7	286.8	283.0	283.0	414.1	238.4	125.4	606.0	192.8	25.3
Acreage Requirements (thousands of acres)										
Single Family 3/	91.1	35.4	34.8	34.8	48.6	27.4	13.3	66.2	17.7	(1.9)
Multiple Family 4/	14.0	7.9	7.9	7.9	8.6	5.1	2.9	13.8	5.2	1.7
	105.1	43.3	42.7	42.7	57.2	32.5	16.2	80.0	22.9	(0.2)

1/ These impacts are the incremental changes in historical SWP activity caused by SWP scenario deliveries for each decade. Positive numbers represent an incremental increase in SWP historical activity (growth), while negative numbers (in parentheses) represent incremental decreases in SWP historical activity.

2/ These estimates are the total levels of socioeconomic activity affected by SWP average annual deliveries over the period 1979-1983.

3/ Assumes 1 acre could accommodate 5 single family units.

4/ Assumes 1 acre could accommodate 20 multiple family units.

C-095126

Table 14: Summary - SWP Impact As Percentage of Total Projected Service Area Increase, With Colorado River Replacement[1/]

	1980-1989			1990-1999			2000-2009		
	Scenario 1	Scenario 4	Scenario 5	Scenario 1	Scenario 4	Scenario 5	Scenario 1	Scenario 4	Scenario 5
Contractor-Irrigated Acreage	45.9%	(45.4%)	(50.3%)	63.4%	67.6%	53.7%	68.7%	53.3%	51.6%
Population	27.9%	27.6%	27.6%	17.7%	9.0%	3.1%	19.6%	4.7%	(1.3%)
Housing Units									
Single Family	24.1%	23.7%	23.7%	20.3%	11.5%	5.6%	20.5%	5.5%	(0.6%)
Multiple Family	19.6	19.5	19.5	19.2	11.4	6.6	22.2	8.4	2.8
OVERALL HOUSING	22.2	21.9	21.9	19.9	11.4	6.0	21.3	6.8	0.9
Acreage Requirements									
Single Family	24.1%	23.7%	23.7%	18.3%	10.3%	5.0%	20.6%	5.5%	(0.6%)
Multiple Family	28.1	28.1	28.1	14.1	8.4	4.8	22.4	8.4	2.8
OVERALL ACREAGE	24.7	24.4	24.4	17.5	9.9	5.0	20.8	6.0	(0.1)

1/ This compares the incremental percentage change in socioeconomic activity caused by SWP deliveries with the total incremental change projected in Table 15. Positive numbers represent an incremental percentage increase in SWP historical activity (growth), while negative numbers (in parentheses) represent incremental percentage decreases in SWP historical activity.

C-095127

Table 15: Summary - SWP Service Area Total Projected Contractors' Acreages, Population, Housing Units, and Acreage Requirements

	1980	1990	2000	2010
Contractor-Irrigated Acreage (thousands of acres)	740.9 1/	779.9	802.4	830.4
Population (thousands of persons)	15,689.2	18,411.5	20,515.4	22,493.6
Housing Units (thousands of units)				
Single Family	3,620.0	4,354.9	4,813.4	5,230.4
Multiple Family	1,883.1	2,441.5	2,775.1	3,119.8
Total Housing	5,503.1	6,796.4	7,588.5	8,350.2
Acreage Requirements (thousands of acres)				
Single Family 2/	724.0	870.9	989.9	1,046.0
Multiple Family 3/	94.1	122.2	155.0	155.8
Total Acres	818.1	993.1	1,144.9	1,201.8

1/ 1981 actual SWP contractor-irrigated acreage.

2/ Assumes 1 acre could accommodate 5 single family units

3/ Assumes 1 acre could accommodate 20 multiple family units.

CHAPTER II. SOUTHERN CALIFORNIA SERVICE AREA

Description and Location

The Department of Water Resources is presently scheduled to deliver State Water Project (SWP) water to the following 13 agencies in the Southern California area: the Antelope Valley-East Kern Water Agency, the Littlerock Creek Irrigation District, the Palmdale Water District, the Mojave Water Agency, the Coachella Valley Water District, the Crestline-Lake Arrowhead Water Agency, the Desert Water Agency, the San Gorgonio Pass Water Agency, the Castaic Lake Water Agency, the San Bernardino Valley Municipal Water District, the San Gabriel Valley Municipal Water District, the Ventura County Flood Control and Water Conservation District, and The Metropolitan Water District of Southern California. These agencies include portions of Los Angeles, Ventura, Orange, Kern, San Bernardino, San Diego, and Imperial Counties.

The Southern California service area will ultimately receive 59 percent of the scheduled annual deliveries of SWP water. Of the service area's maximum annual entitlement, approximately 80 percent (nearly half the total SWP entitlement) will go to The Metropolitan Water District of Southern California (MWD). SWP entitlement for this service area will be used primarily for M&I purposes.

Figure 3 shows the location of the Southern California SWP service area in the State. Figures 4 and 5 depict the service area in detail.

Environmental and Socioeconomic Profile

Physical and Biological Environment

Following is a description of the physical and biological environment in the Southern California service area. Factors described in this section include climate, soils, vegetation, wildlife, rare and endangered species, and air quality.

Climate. From seashore, to mountain summits, to deserts, the Southern California service area exhibits several climatic types. It is not totally accurate to label the area's climate as "Mediterranean" alone, since such descriptions as "semiarid," "near desert," or "desert" are all valid. Considerable differences exist within different sections of the service area.

Generally, temperatures rise as one moves farther inland. Temperatures decrease with altitude in the mountains and create a succession of climatic zones ranging from hot summers at the base to severe winters at the higher peaks. Average annual temperatures along the coast and in the valleys range from 50°F to 70°F and allow the year-round growth of a variety of crops.

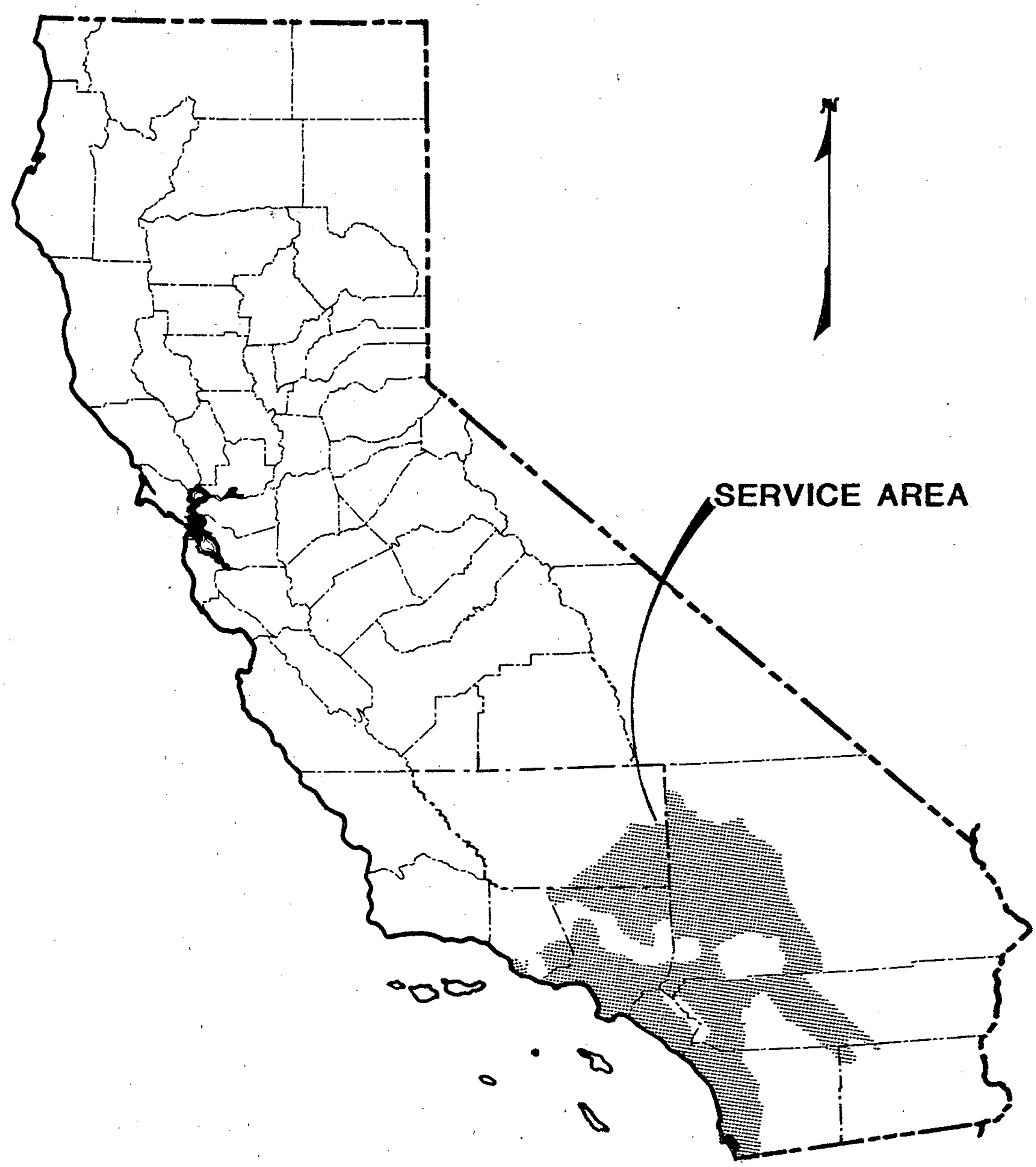

Figure 3 -
SOUTHERN CALIFORNIA SWP SERVICE AREA
STATE WATER PROJECT CONTRACTORS

Figure 4. SOUTHERN CALIFORNIA SERVICE AREA
WESTERN PORTION

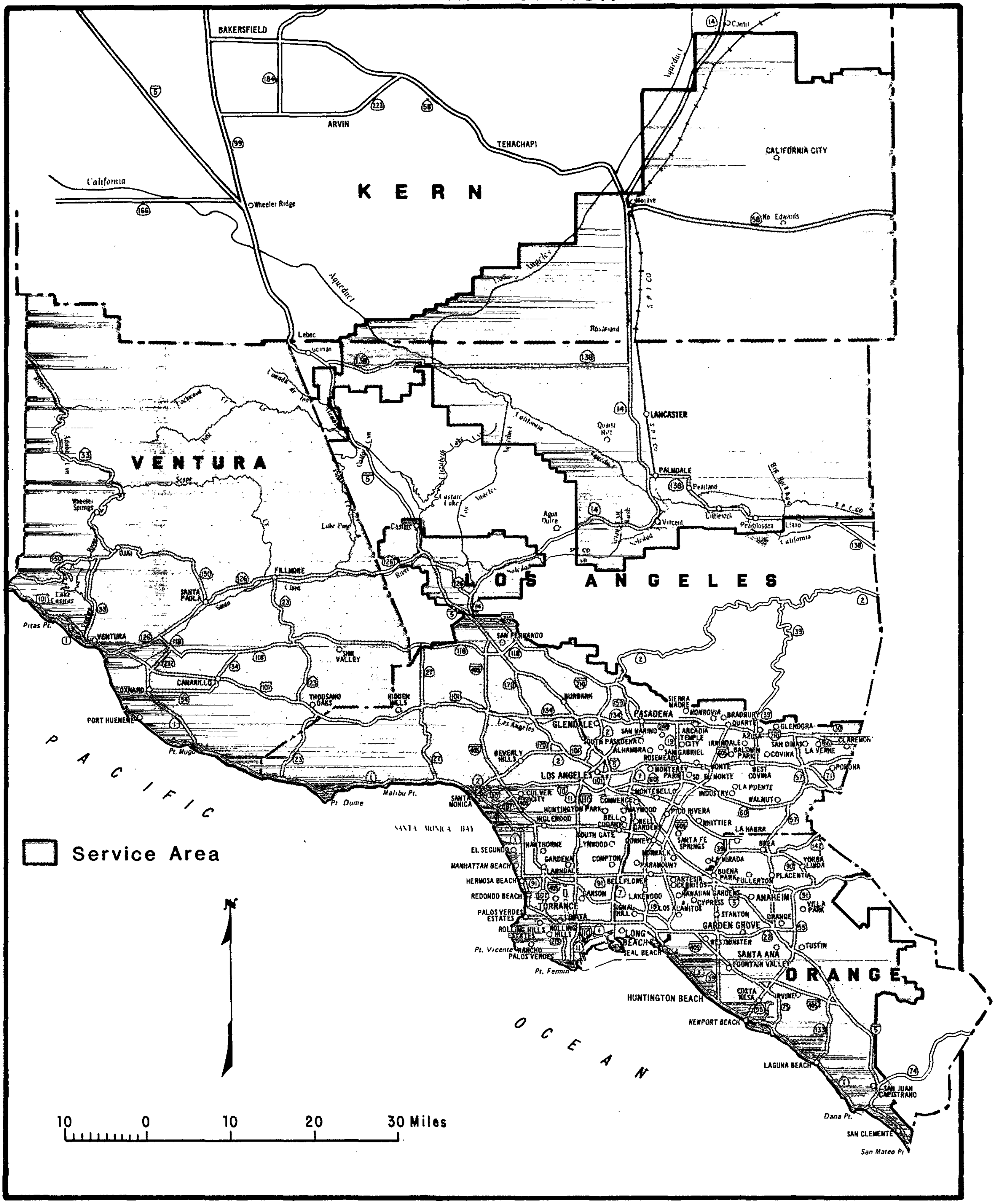

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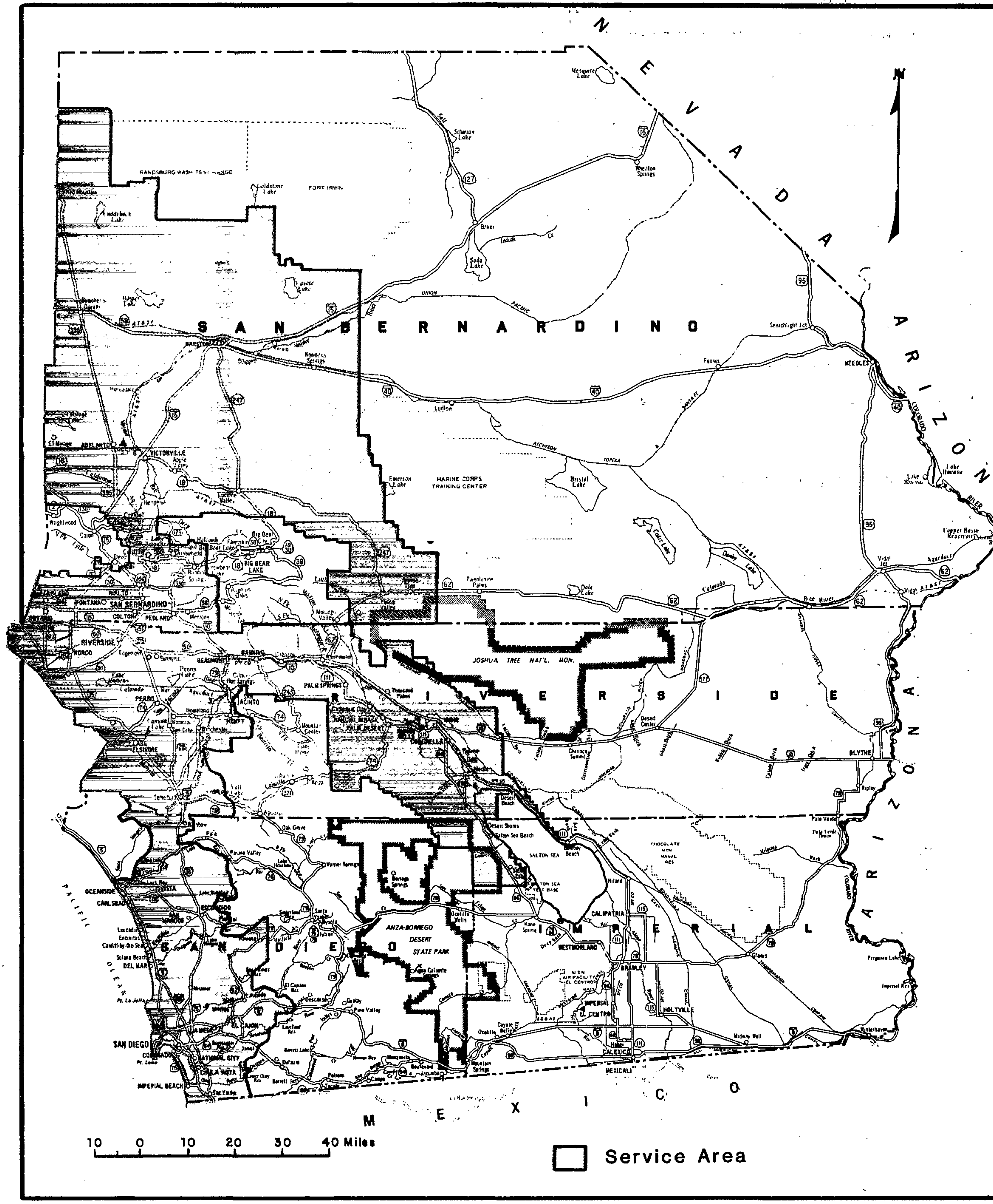
Figure 5. SOUTHERN CALIFORNIA SERVICE AREA
EASTERN PORTION



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Average temperatures in the deserts range from around 50°F in the winter to 90°F in the summer.

Rainfall in the service area generally depends on latitude, elevation, and exposure. It ranges from an annual average of 16 to 20 inches along the coast and in the valleys, to less than 4 to 8 inches in the high and low deserts.

Soils. Several soil-associated problems such as erosion, drainage, salinity, toxicity, and compaction are present within the Southern California service area. While some of the problems are induced by human activity, certain of them are characteristic of the soils and subsequently should be considered limiting factors to the use options for these lands.

The level farmlands of the Imperial, Coachella, and Palo Verde Valleys receive relatively little rainfall and have few water erosion problems. In some areas, however, such as Rancho California in Riverside County, complete clearing of steeper slopes has led to severe erosion.[1] Increasing urbanization in the service area is also a significant cause of erosion and sedimentation, especially when rural foothill areas are converted to suburbs. Landsliding is another extensive problem that can be aggravated by converting forest and brushlands to rangeland or urban use.

Another problem in some locations in the service area is wind erosion, which can reduce the productivity of the soil resource, damage crops, and pollute the atmosphere with dust. The Mojave Desert, with its severe climatic factors, is more vulnerable to this problem than is any other area in the West. Wind erosion affects almost 70 percent of the rangeland in the service area to some degree. The greatest problems occur largely on federal rangeland in San Bernardino County. Overgrazing and extensive off-road vehicle use are among the principal causes.

The service area has a comparatively high percentage of croplands with drainage problems involving high water tables and high levels of salts in the soils. Extensive drainage systems would help reduce this problem and aid intensively cropped areas in maintaining a favorable salt balance. Drainage systems combined with leaching of salts could also improve the toxic salt problem that affects many of the croplands in the area.

Compaction, which reduces the porosity of soil, has a significant impact on cropland. It compounds drainage and erosion problems and affects agricultural productivity. Compaction occurs

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1/ State of California, State Water Resources Control Board, A Report on Critical Erosion on Agricultural Sites in California, 1977.

most often in intensively farmed croplands such as those in the south coastal valleys.

Vegetation. While some of the naturally occurring vegetation in the Southern California service area has been altered significantly by urban and agricultural development, a large part of the region (mostly uplands) retains its native cover. The principal types of vegetation are chaparral, scrub, grassland, woodland, and forest.

Chaparral, the most common plant community in the service area, represents the typical Southern California vegetation. It is generally found on hot, dry slopes, ridges, and mesas and often on poor soils that are shallow and sandy and have low water-holding capacity.

Coastal and inland sage are two important scrub communities in the service area. The latter is usually found on dry slopes below 3,000 feet on the coastal side of the mountains. Other scrub communities include the creosote bush scrub community, which occupies the desert floor and its lower slopes, and the succulent scrub community found in scattered locations throughout the southern desert.

The native grassland has been largely converted to agricultural and urban uses. On some lands, overgrazing has caused European annual grasses and herbs to replace native perennial bunch grasses and forbs.

Woodland communities include the foothill woodland community, a transition zone between the grassland and forest communities, the pinyon-juniper woodland found in the higher elevations of the Mojave Desert, and the Joshua tree woodland community in the lower desert.

The forest community occurring in the service area is coniferous forest. It is found only in the higher elevations of the Transverse Ranges (Santa Ynez, Santa Monica, Santa Susana, San Gabriel, and San Bernardino Mountains), and the Peninsular Ranges (Santa Ana, San Jacinto, Santa Rosa, Palomar, Cuyamaca, and Laguna Mountains).

Wildlife. The Southern California service area supports a great diversity of wildlife. Because there are so many species, only the most abundant in each plant community will be mentioned here.

The most dominant animal in the chaparral community is the mule deer. Other common mammals in this habitat include coyotes, bobcats, foxes, woodrats, and skunks. Many smaller animals such as rabbits, chipmunks, and rodents are also plentiful. Several resident birds such as thrashers, wrentits, bushtits, and jays, and migrant birds such as sparrows, warblers, and robins also use this habitat. Reptiles are very abundant throughout this community. Amphibians occur in locations where moisture is continuously present.

The sparse-looking sage scrub community supports a large number of resident species. Several amphibians and reptiles are found here. Resident bird species include towhees, sparrows, wrens, and quail. Creosote brush scrub supports several species of lizards and snakes. Mammals supported by this community include coyotes, foxes, skunks, and mice.

The grassland community provides habitats primarily for grazers and seed eaters. Several species of mice are found here, especially in disturbed areas. Ground squirrels tend to favor cultivated areas, while rabbits are found in areas where sufficient brush cover is available. Coyotes, the most abundant carnivore in this community, are found around canyon mouths. This community also supports several species of predatory birds such as owls, hawks, and eagles, and several species of seed-eating birds such as sparrows, doves, and quail. Grasslands also support several species of amphibians and reptiles.

The foothill woodland community provides roosting and nesting sites for many bird species, especially for raptors such as hawks and eagles. Several species of woodpeckers are commonly found in this habitat. The pinyon-juniper woodland community supports species that are also found in desert and coniferous forest communities. Jays, wrens, warblers, and orioles are common inhabitants of this community.

The coniferous forest community supports several species of birds, including woodpeckers, nuthatches, and creepers. Dominant mammals include deer, coyotes, and mountain lions. California mountain kingsnakes, lodgepole chipmunks, and porcupines are found only in this type of habitat.

The coastal area, which includes coastal strand, tidal mudflats, rocky and sandy beaches, estuaries, and marshes, contains the greatest number and diversity of fauna in the service area. The coastal strand community is an important feeding and roosting ground for shorebirds, such as plovers, turnstones, sandpipers, and gulls. Common residents of this community include squirrels, raccoons, and several small lizard and rodent species.

Marshes are the least common and most sensitive type of habitat in the service area. They have been disturbed by urban growth and are rarely found undisturbed. Marshes provide habitat for migrating waterfowl and shorebirds, amphibians, western pond turtles (in fresh water), and a few small endemic mammals, primarily mice (in salt water).

Rare and Endangered Species. The diversity of habitats available in the Southern California service area, combined with a rapidly developing human population, has resulted in a large number of rare and endangered plant and wildlife species. A list of rare and endangered species designated by the California Department of Fish and Game (DFG) that may occur in the service area is shown in Table 16. (All tables referred to in this chapter appear at the end of this chapter.)

Tui

The Mojave chub, an endangered species on both State and federal lists, is restricted in its native range to the Lake Tuendue and Fort Soda Springs areas on the west side of Soda Lake near Baker, in San Bernardino County. While not within the service area, because of its proximity to it, this species could be affected by future service area growth.

FXS

Extirpated throughout most of its known range, the endangered unarmored threespine stickleback occurs only in the upper portions of the Santa Clara River in Soledad Canyon. It is threatened by increased recreational use and development in the canyon, and any further alteration of its habitat could lead to its extinction.

FXS

The endangered desert slender salamander is known to occur only in the Hidden Palm Canyon area south of Palm Desert in Riverside County. The DFG manages the Hidden Palm Ecological Reserve, which encompasses the known habitat of this species.

FT/SE

The Coachella Valley fringe-toed lizard is restricted to the Coachella Valley region in Riverside County. This species has already lost over half its original habitat and is continuing to lose habitat to developmental pressures.

ST

The southern rubber boa is known to occur in the San Bernardino Mountains in San Bernardino County and near Idyllwild, in Riverside County. In Ventura County, this species probably occurs in high coniferous areas of the Los Padres National Forest near Mount Pinos. The principal threats to this species are recreation (resort development), smog, logging, and wood gathering.

(FE/SE

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~~The California brown pelican fish in the coastal waters nests at the Channel Islands National Monument on Anacapa Island and on Santa Barbara Island and the Los Coronados Islands. This subspecies feeds in the open sea near the mainland and the islands and is occasionally seen on shore.~~

~~California condor populations in the service area are limited to the mountainous and valley areas of Ventura and northwestern Los Angeles Counties. In the northern portion of Ventura County, the Sespe Condor Sanctuary has been established within the Los Padres National Forest as a special nesting and refuge area to protect the condors' habitat from development and encroachment.~~

FE/SE

Historically, bald eagles bred in Southern California. Today, however, they no longer breed there but continue to use the region to a much lesser degree for wintering. Eagles occasionally occupy the habitat surrounding Castaic Lake, Pyramid Lake, and Bouquet Reservoir in Los Angeles County and Lake Piru and Casitas Reservoir in Ventura County.

Coastal and inland marsh and riparian areas are important for American peregrine falcons. The falcon occurs all along the Ventura County coastline and sometimes along the Santa Monica coastline. The lagoon and salt-water marsh on the Point Mugu Naval Reservation is also a popular spot for this species.

The light-footed clapper rail SE occurs in the Mugu Lagoon area, as well as in Bolsa Chica Lagoon and the Anaheim and Upper Newport Bays in Orange County. It also occurs along the mouths of the Santa Margarita and San Dieguito Rivers; in the Batiquitos, San Elijo, and Los Penasquitos Lagoons; and in the Mission Bay and San Diego Bay Marshes in San Diego County. Salt marshes with cord-grass-pickleweed associations provide the best habitat for these birds.

The California black rail (SE) is known to occur in the Upper Newport Marsh in Orange County and in San Elijo Lagoon in San Diego County. Destruction of these and other wetlands by filling or draining continues to threaten the existence of this species.

The California least tern (FE/SE) occurs along the coast where it feeds mainly in lagoons, stream mouths, or canals. This species nests along the shoreline in relatively flat, undisturbed areas. The service area contains most of the nesting sites for this species. San Diego County alone contains about 50 percent of the population's nests. Human disturbance and the continuing destruction of feeding and nesting habitats is a significant threat to this species.

The California yellow-billed cuckoo (SE) occurs along the Santa Ana River in Riverside County. Over 1,300 acres along the river have been acquired by the Wildlife Conservation Board to protect the species' sparse breeding populations.

The range of the least Bell's vireo (FE/SE) has been reduced to scattered riparian habitats in the Southern California area. Its population has been significantly reduced by parasitism by the brown-headed cowbird.

The Belding's savannah sparrow SE can be found along the coastline in salt marshes with cord-grass-pickleweed associations. Its range is similar to that of the light-footed clapper rail.

The Mohave ground squirrel ST occurs in the western portion of the Mojave Desert in San Bernardino County. It occupies a wide variety of desert habitats. The greatest threat to this species is urbanization and agricultural development, which are rapidly reducing the squirrel's habitat. Range competition with the round-tailed ground squirrel is also contributing to its decline.

(FE/ST)

The Stephen's kangaroo rat is known to occur in fewer than 20 isolated localities. Most of the sites are located in western Riverside County. This species is seriously threatened by habitat destruction caused by urbanization and agricultural development.

(ST)

Peninsular bighorn sheep are known to occur in the San Jacinto and Santa Rosa mountains in Riverside County and in the southern mountain ranges of San Diego County. This rare subspecies is continuing to lose habitat and is threatened by drought and human disturbance, including illegal shooting. Despite increasing efforts to protect the bighorn sheep, its numbers are decreasing.

Air Quality. The Southern California service area encompasses all or part of the South Central Coast, South Coast, San Diego, and Southeast Desert Air Basins. The ambient air quality within and among these basins varies considerably because of diverse climatic and topographic features that exist in each.

In Ventura County (South Central Coast Basin), attainment standards for ozone and total suspended particulates (TSP) are being exceeded.

Standards for ozone, TSP, carbon monoxide (CO), and nitrogen dioxide (NO) are exceeded in the South Coast Basin counties of Orange, Los Angeles, Riverside, and San Bernardino. This basin is, however, in compliance with federal standards for sulfur dioxide and lead. NO standards are expected to be met in the South Coast basin by 1987 under the latest Air Quality Management Plan. Standards for hydrocarbons, CO, TSP, and ozone are expected to continue to be exceeded beyond the 1987 attainment deadline.

Air quality in the San Diego Basin is strongly influenced by inversions and amounts of available sunlight. This basin is a nonattainment area for ozone and TSP.

The Southeast Desert Basin generally has good air quality, although some violations of State and federal ozone standards occur because pollutants drift in from outside the basin. The basin is a nonattainment area for ozone and TSP.

Economic Activity

The Southern California service area is the State's leading center of business activity. Although the Southern California economy is subject to fluctuations of the national economy, in general this region's economy performs better than the rest of the country because of a different economic structure. In contrast to many other regions in which manufacturing is oriented towards durable goods for consumers, Southern California's major manufacturing is in the aerospace/electronics sector. This industry group accounts for more than one-fourth of the region's manufacturing income and a third of its total manufacturing employment. Historically, petroleum refining has been a major manufacturing concern within Southern California; it now ranks third (in terms of value added) behind guided missiles, space vehicles, and aircraft. Oil from foreign countries and Alaska, as well as California-produced supplies, is refined in Southern California. Other major manufacturing industries include metals fabrication, chemical production, food processing, and paper production.

The Southern California economy is also oriented to the services sector. The trade, services, finance and insurance, and transportation and public utilities sectors together account for 56 percent of the service area's nonfarm employment. (At the national level, the share is 53 percent.) Southern California services have also been serving international markets, reflecting the emergence of Los Angeles as an important international financial center and the region's increased popularity with foreign tourists.

During the 1970s, the public sector of Southern California grew steadily. However, passage of Proposition 13 in 1978 led to a reduction in the number of State and local governmental jobs.

Although, since World War II, rapid urbanization of the Los Angeles and San Diego metropolitan areas has diverted farm acreages to urban uses, agriculture remains an important economic pursuit. In the region's urbanized areas along the coast, most of the remaining agricultural activity is accounted for by high-value crops such as nursery plants and cut flowers, citrus, vegetables, strawberries, and avocados. Agriculture also stimulates related industries in the region, such as food processing, transportation, and wholesale trade.

Security Pacific Bank anticipates that, during the remainder of the 1980s, the basic industries in Southern California (aerospace/electronics, tourism, petroleum production, and agriculture) are likely to perform well. It also anticipates that the sectors of business and professional services, health services, and finance will also register above-average growth in this decade. However, the government sector is likely to experience slower growth rates than in previous years.

Population

Southern California has changed from a relatively rural life style based on an agricultural economy in the early 20th century to the present highly urban/industrial society. During the 1970s, this region was particularly affected by the national shift in population toward the southern and western regions. Between 1970 and 1980, population growth in Southern California averaged 1.7 percent per year, compared with a 1.1 percent annual growth rate for the nation. About half this growth came from net in-migration.

Southern California's population growth rates should soon exceed the national average, primarily because of the region's healthy industrial mix and attractiveness to new residents. Between 1980 and 1990, population growth in Southern California is expected to increase at an annual average rate of 1.5 percent. The national increase is forecast to be 0.9 percent per year. Most of the growth in Southern California is expected to occur in suburban areas.

Table 17 presents estimates of the 1980 Southern California service area population and forecasts for 1990, 2000, and 2010. In 1980, the service area population was nearly 13.2 million; this is expected to reach almost 19.0 million by 2020.

Water Supply and Demand

Table 18 presents local and imported water supplies in the Southern California service area for 1980 through 2010. Two sources are shown: one for full SWP entitlement and one with no additional SWP supplies. Also evident in the table are reductions in Colorado River supplies (from about 1.5 million acre-feet in 1980 to about 0.7 million acre-feet by 2010) due to future diversions to the Central Arizona Project and increased water rights awarded to the lower Colorado River Indian tribes. The table also includes current waste water reclamation levels, and allowances for potential increases in reclamation.

Projected urban and agricultural water demands from 1980 to 2010 (with allowances for projected urban conservation) are shown in Table 19.[2/] With full SWP entitlement, total demands exceed total supplies, beginning in 2010. With reduced SWP entitlement, total demands exceed total supplies, beginning in 1990.

Compensation for Reduced SWP Entitlement

The Metropolitan Water District of Southern California (MWD) will ultimately be allocated about 81 percent of the

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2/ Urban water conservation measures include educational and public information, water management programs, regulations, and water emergency plans. These are described in detail in the SWP Recommended Water Management Plan for The Metropolitan Water District of Southern California, 1982.

Southern California service area's SWP urban yield and 68 percent of the total SWP urban yield. Because the MWD is such a large contractor, an analysis was made of four demand reduction alternatives and five supply augmentation options in the MWD service area that might be available to help compensate for reduced SWP entitlement deliveries.[3/] Use of these alternatives would reduce the maximum dry-year impacts presented later in this report.

Water Demand Reduction Alteratives

The water-saving alternatives include extraordinary water conservation options to reduce demand. These measures were assumed to be applicable only under conditions of shortages.

The extraordinary conservation options go beyond the measures in the Department's recommended water management plans. These measures include toilet dam retrofits, showerhead retrofits, free residential landscape design, and mandatory nonresidential landscape design. Implementation of the four measures would reduce 1990 level demands by an estimated 137,000 acre-feet. This amount represents about 4 percent of net demands in MWD's service area, 10 percent of MWD's demand from the SWP, and 4 percent of the total 1990 SWP demand.

Because of uncertainties related to health concerns, urban waste water reclamation beyond that assumed for the management plans was not considered. Also, industrial conservation measures beyond those assumed for the water management plans were not considered because of the relatively small amounts involved and the extreme complexity in assessing further conservation options.

Toilet Dam Retrofit. This would be a one-time program of free device installation. The cost includes devices, installation, publicity, and program management. A 15-year life was assumed for a free toilet dam program (carried out along with a free low-flow showerhead program). An installation rate of 89 percent and a long-term retention rate of 83 percent (of total households) was assumed. Water savings for toilet dam devices were those given in Department of Water Resources' Bulletin 191, A Pilot Water Conservation Program, October 1978.

This option would yield an estimated 60,000 acre-feet annually through 2000, decreasing to zero by 2010. Estimated unit cost is $74 per acre-foot. No significant environmental problems are anticipated. However, water agencies installing the devices

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3/ Information in this section was obtained from the Draft Environmental Impact Report: Proposed Additional Pumping Units, Harvey O. Banks Delta Pumping Plant, Department of Water Resources, November, 1982.

would incur some risk of liability for ensuring improper toilet operation or for other reasons.

Combined State Water Project and local energy savings in 1990 would be about 181 million kilowatthours. These energy savings would occur in normal years when deficiencies are not being imposed.

Showerhead Retrofit. A free low-flow showerhead installation program would be conducted along with a toilet dam program. The estimated initial cost of the showerhead and toilet dam retrofit programs is $90 million. An installation rate of 76 percent and a long-term retention rate of 73 percent were assumed. Water savings for low-flow showerhead devices were those given in Bulletin 191. All the free low-flow devices would be expected to be replaced by 2000 with owner-purchased low-flow showerheads (State-mandated manufacturing regulations will require low-flow devices).

This option would yield an estimated 38,000 acre-feet per year in 1990, decreasing to 17,000 acre-feet per year in 1995 and to zero by 2000. Estimated unit cost is $110 per acre-foot. No significant environmental impacts are anticipated. There may be some liability risk.

Combined State Water Project and local energy savings would be about 114 million kilowatthours per year in 1990. These energy savings would occur in normal years, when deficiencies are not being imposed.

Free Residential Landscape Design. This would be a service offered to owners of new homes. Cost per design is estimated to average about $67. One-third of 30,000 designs are expected to be adopted each year through 2000. After 2000, half of 10,000 designs would be adopted.

Water savings were estimated at 0.2 acre-foot per year per landscape. This would yield an estimated 22,000 acre-feet per year by 1990, increasing to 91,000 acre-feet per year by 2035. These yield estimates are gross savings at the point of use; they include adjustments for runoff returns to usable ground water basins. Unit cost is $167 per acre-foot. No significant environmental problems are anticipated. Some institutional problems might be involved, such as funding and design responsibilities.

Combined State Water Project and local energy savings in 1990 would be about 66 million kilowatthours per year. These energy savings would occur in normal years when deficiencies are not being imposed.

Mandatory Nonresidential Landscape Design. Regulations would require that new commercial, governmental, and industrial landscapes of a low water-use design. Up to 2000, it is expected that this regulation would apply to enough new landscapes to cumulatively add 1,700 acre-feet of savings each year. After 2000, the yearly cumulative gain in savings would drop to 1,200 acre-feet. An annual cost of $220,000 would be required to achieve the expected 40 percent water savings for the new landscapes. This would yield an estimated 17,000 acre-feet per year by 1990, increasing to 73,000 acre-feet per year by 2035. These are gross water savings. Unit cost is $11 per acre-foot. Environmental problems should be minimal. Institutional problems involved would be the cooperation of government agencies for enforcement of regulations.

Combined State Water Project and local energy savings would be about 51 million kilowatthours per year in 1990.

Water Supply Augmentation Alternatives

The five opportunities to augment water supply include Imperial Valley conservation and transfer, Imperial Valley drainage water desalting, San Joaquin Valley drainage water desalting, Riverside County drainage water desalting, and ground water desalting. All these programs have significant yields. The annual savings resulting from the Colorado River conservation improvements program alone are estimated to be between 285,000 acre-feet to 438,000 acre-feet. However, there are substantial water quality costs due to the lower quality water.

Imperial Valley Conservation and Transfer. Opportunities exist to salvage water within the Imperial Valley. A program of canal lining, reservoir regulation, irrigation management, seepage recovery systems, and on-farm tailwater recovery systems would permit substantial irrigation water savings. This program would allow Imperial Irrigation District to reduce its Colorado River diversions, leaving more of California's Colorado River entitlement available for diversion by The Metropolitan Water District through its Colorado River Aqueduct under its existing Boulder Canyon Project contract with the United States.

Discussions are under way on a program in which MWD would finance water-saving improvements in the Imperial Irrigation District system. This program has statewide significance because any water that MWD can obtain by water salvage directly reduces its need to import water from Northern California. Estimates of annual water savings resulting from these improvements vary from 285,000 acre-feet to 438,000 acre-feet per year.

Estimated unit costs are about $425 per acre-foot, which includes substantial urban water quality costs (increased costs for replacement of plumbing and appliances and for water softening due to substitution of the lower quality Colorado River water for SWP water). The estimated cost of damage due to poor quality water to MWD customers is $0.3049 per milligram/liter (mg/L) total dissolved solids (TDS) per acre-foot. Study results for MWD's service area were modified by deducting the cost of central softening and bottled water from the total penalty cost. This was done because MWD does not use central softening, and it was assumed that any quality change resulting from using additional Colorado River water would not change the taste of the water enough to affect sales of bottled water.

Unknown impacts on the Salton Sea could be mitigated by funding environmental studies and possibly by salinity control. Impacts associated with lower quality water in the MWD service areas could possibly be mitigated by desalting, which is included in the following water supply alternatives.

Imperial Valley Drainage Water Desalting. Imperial Irrigation District could use desalted agricultural drainage water in lieu of Colorado River deliveries. As with the Imperial Valley conservation and transfer alternative, MWD would then divert a corresponding amount from the Colorado River Aqueduct. The cost of transportation through the aqueduct, as well as the cost of substituting the lower quality Colorado River water for urban use, was taken into account. The benefit to irrigated agriculture of using the higher quality desalted water (500 mg/L TDS) rather than Colorado River water (700 mg/L TDS) was not subtracted from the cost of this alternative because of the complexities involved. Estimated yield is 302,000 acre-feet by 1990 and thereafter. Unit cost is estimated at $648 per acre-foot, including $40 per acre-foot for energy for local distribution.

Some of the environmental impacts and institutional problems under this option would be similar to those for Imperial Valley conservation. Additional problems involved are the location of desalting plants and salt (brine) disposal. Such unknown impacts could be mitigated by funding environmental studies.

San Joaquin Valley Drainage Water Desalting. A program of desalting brackish agricultural drainage water would allow further local reuse of that wter as a substitute for water imported from the Delta. The desalted supply would not be a direct cost substitute for imports, due to reduced water quality. Because of leaching requirements, it was estimated that 500 mg/L TDS of the desalted water would be about 94 percent as effective for crop irrigation needs as the 280 mg/L TDS of State Water Project imports. Estimated yield is 190,000 acre-feet in 1990, increasing to 319,000 in 2010. Estimated unit cost is $409 per acre-foot, including local distribution energy costs at $40 per acre-foot.

Institutional problems under this alternative are not as clearly defined as for the Imperial Valley options, but they could be similar. Environmental problems include salt brine disposal.

Riverside County Drainage Water Desalting. Water provided from this source was assumed to be directly available for urban use. The quality penalty (substitution of 500 mg/L TDS desalted water for 280 mg/L TDS State Water Project water) was taken into account. Estimated yield is 42,000 acre-feet per year by 1990 and thereafter. Estimated unit cost is $490 per acre-foot.

No major institutional problems were identified for this alternative. Environmental problems would be similar to those for San Joaquin Valley desalting, but on a smaller scale.

Ground Water Desalting. Locations and quantities of desalted water available from this source are listed below:

County	Annual Yield (Acre-Feet)
San Luis Obispo	1,000
Santa Barbara	10,000
Ventura	10,000
Los Angeles	16,000
Riverside	11,000
Orange	3,000
San Diego	20,000
San Bernardino	2,000
Total	73,000

The cost of ground water pumping and the cost of substituting the lower quality desalted water were included in the cost of this source of supply, estimated at $526 per acre-foot.

No major institutional problems were identified. Environmental problems would be similar to those of other desalting programs.

Drought Contingency Measures

When water supplies become critically low, as occurred during the 1976-1977 drought, several contingency measures can be implemented temporarily to reduce economic impacts. However, if few or no additional SWP facilities are added in the future (such as with Scenarios 4 and 5), and with projected increasing demands, the likelihood of drought situations will increase, making it more difficult to implement these contingency measures. The measures described below are temporary solutions.

Conservation - Rationing

Conditions in 1977 showed that urban residents will conserve water voluntarily to a certain extent without mandatory rationing, if they perceive an emergency or a realistic temporary need. Experience has shown that up to a 50 percent reduction in residential use can be achieved. Where the situation is critical, mandatory rationing may be necessary to attain the fullest reduction of water use required. Savings in the residential sector can be passed on to the industrial sector, thereby reducing economic impacts.

Industries also can cut back water use for short periods but generally not nearly as much as urban residents, without economic loss or reduction in jobs. However, over a long period of time, shifts in industrial water-using technology can occur, thereby reducing water needs.

Ground Water

In many areas of the State, ground water supplies exist that can be used during dry years. However, there are serious problems from continued reliance upon ground water supplies:

- o Declining ground water tables.
- o Availability of electrical equipment and possibly energy for pumping.
- o Possible damage from land surface subsidence and salt-water intrusion in susceptible areas.

Exchanges

Exchanges can be based on the physical transfer of water, relinquishing an entitlement to a water supply, or the substitution of water supply, such as reclaimed waste water or ground water, to permit use of the normal supply by another water-deficient agency.

Some areas of the State have access to more abundant water supplies than other areas, and not all areas will be equally affected by a drought. For example, in 1977, Southern California had access to stored water from the Colorado River basin which, although affected by the drought, had large quantities of water in storage in the lower Colorado River reservoirs. In 1977, exchange agreements accomplished the transfer of more than 355,000 acre-feet of water from the State Water Project's Southern California contractors to other areas of need. Water agencies in Southern California were able to forego entitlement to some Northern California water by using more Colorado River water, by implementing water conservation programs, and by temporarily overdrafting local ground water basins. In the Central Valley, water exchanges occurred between individual farmers and between irrigation agencies.

While most of the major urban areas and much of the irrigated areas have the physical capability to transfer water, many smaller and less developed areas cannot be served by exchanges. There are also legal and institutional constraints. Thus, exchanges cannot be expected to solve all of the problems in a drought, but where physically possible and institutionally feasible, exchanges can be a major drought strategy.

Water Hauling

Although inconvenient, hauling water when local supplies have run out is a simple expedient for individual residences or small communities. In fact, it is the only practical option for some individuals and small communities where ground water and surface water supplies are depleted by drought. The costs can be nominal if distances are short and quantities of water are small but quite high if long distances are involved and quantities are large. Hauling facilities can vary from a small container in the family car to large tank trucks or railroad tank cars. Costs also depend on the price of water charged, if any, by the agency or individual at the water source.

Water quality must also be considered, especially where public health is involved. Tank trucks or containers that have been used for toxic materials should not be considered for hauling water. It is practically impossible to remove all highly toxic materials such as pesticides and herbicides from containers. Local health officials are responsible for the quality of public water supplies.

Impacts of Future SWP Deliveries

Economic Impacts

Economic impacts are the economic consequences of a project or other action. The direct income and employment impacts discussed below are the differences in the Southern California economy caused by a reduction of future SWP deliveries from Scenario 1 (full entitlement) to the lower entitlement levels of Scenarios 2 through 5. Because direct economic impacts in Southern California will ripple throughout the State, losses to statewide direct, indirect, and induced income and employment are also presented. The difference in socioeconomic activity between Scenarios 1 and 5 represents the maximum impact that occurs during a dry year.

Income. The average annual income impacts between scenarios are shown in Table 20. During the 1980s, the income impacts between Scenarios 1 and 5 are insignificant because the Southern California service area has requested less SWP water than it would be allotted if no additional SWP facilities are built.[4/] By 2000, the average annual direct income impact in the service area (between Scenarios 1 and 5) is about $4.8 billion; the statewide direct, indirect, and induced impact is about $16.6 billion. Beyond 2020, if SWP deliveries are reduced from Scenario 1 to 5, then the firm yield annual direct income loss to the Southern California economy is about $12.4 billion. Statewide, the firm

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4/ See Table 2 for comparison of Scenarios 1 and 5 water deliveries for this service area.

C-095147

yield annual direct, indirect, and induced income loss is about $42.0 billion.

Employment. Average annual employment losses caused by SWP reductions are presented in Table 21. As in the income analysis, the employment impact between Scenarios 1 and 5 is insignificant during the 1980s, but this changes dramatically in later years. Beyond 2020, the firm yield annual direct employment impact in the service area resulting from reduced SWP deliveries from Scenario 1 to 5 is about 332,300 person-years. Statewide, the firm yield annual reduction in direct, indirect, and induced employment is about 1,985,900 person-years.

Social Impacts

Economic impacts provide aggregate indications of changes in the economy of a region; social impacts are indicators of the social well-being of a region. While some social impacts can be quantified (for example, changes in populations and housing units), such effects as changes in the quality of life cannot.

Population. Population impacts in the Southern California service area are shown in Table 22. During the 1980s, population impacts are insignificant, even with reductions in SWP entitlement, but after 2020, the firm yield annual population decrease between Scenarios 1 and 5 totals about 3,494,800 persons.

Housing Units. Housing unit impacts by decade are compared in Table 23. As with population, housing unit impacts are insignificant during the 1980s, but after 2020, the firm yield annual housing unit difference between Scenarios 1 and 5 is about 1,426,100 units.

Social Services. The impact of increased water supplies upon social services in the service area will be mixed. This report indicates increases in income and employment, both at the local (service area) and State levels. As a result, the State and local governments could experience some increase in revenues from taxes and other sources. However, additional socioeconomic activity can also place a strain upon local agencies because of the increased levels of services they must provide for this population. Many communities have found growth to be a mixed blessing because the costs of providing services have frequently outstripped revenues.

Environmental Impacts

The environmental consequences of future SWP water deliveries to the Southern California service area are presented in the following section. The direct and indirect environmental impacts are the differences in the environment caused by reducing future deliveries from Scenario 1 (full entitlement) to the lower entitlement levels of Scenarios 2 through 5. Because the primary use of SWP water in this service area is municipal and industrial (M&I), most impacts will focus on new and existing urban and industrial development that could be affected by this water supply. Economic opportunities (such as increased income and employment in water-related industries) provided by the delivery of SWP supplies to this service area will support growth, which in turn affects such environmental factors as land use, vegetation, wildlife, and water and air quality.

The effects of using future SWP increases to replace existing Colorado River supplies are also examined. As part of the impact analysis, it has been assumed that SWP firm supplies could replace the Colorado River water that will be lost (over 0.8 million acre-feet), and if increases in future SWP firm yield up to this amount were used to replace these lost supplies, they would be regarded as maintaining present land use, not as potential growth. Another assumption examined in this analysis is that SWP supplies do not replace lost Colorado River supplies.

The scope of this report does not allow for the identification of specific lands that might be converted to urban uses. It is therefore difficult to predict with any degree of certainty where specific impacts will occur in the Southern California service area. Environmental values change from one locale to another, and an action that would benefit one area could destroy important values in another.

Land Use. Continued urban growth is forecast for the service area, and pressure for urban and suburban land is expected to become more intense as developable land becomes scarcer. Conversion of agricultural lands to urban uses will continue, despite increasingly greater emphasis given to the preservation of agricultural lands throughout the State. Service area counties expected to receive the greatest pressure for urban growth include Ventura, southern Orange, Riverside, western San Bernardino, and western San Diego. According to the Southern California Association of Governments, most of the region's growth will occur in outlying urban areas, particularly in the eastern portion of the coastal plain. In addition to this expansion, infill and recycling is forecast for northern Orange County and central Los Angeles County. The greatest amount of new growth in Los Angeles County is expected to occur in the Antelope and San Fernando Valleys. In San Bernardino County, the largest growth will take place in the Chino Basin and the San Bernardino Valley area. In Riverside County, the population is expected to nearly double, with one-third of this growth occurring in the Riverside-Corona area. The area around Palm Springs is also expected to grow considerably.

As developable land becomes scarce, as it already has in some areas of Orange and Los Angeles Counties, pressure to develop land that contains wildlife habitat will increase. Local agencies will have to purchase and preserve lands with significant biological resource value.

Projected total population, housing units, and acreage requirements for the Southern California service area are shown in

Table 24. The SWP will affect projected land use in the service area, primarily through its impact upon population and required acreages for housing.

Comparisons of Scenario 1 impacts with the historical activity associated with the SWP indicate total growth resulting from full deliveries (Tables 25 and 27). During 1979-1983, a total of about 1,916,100 persons per year were affected by SWP deliveries. To determine the relative size of this estimate, it should be compared with the total population of the Southern California service area in 1980, or about 13,195,800 persons (from Table 24).

Between 1980 and 1989, it is estimated, the full deliveries of the SWP will affect an additional 752,000 persons above the historical average (Table 25). This impact is about 33.1 percent of the service areas's total projected population increase (Table 26). During the 1990s, Scenario 1 deliveries, without adjusting for Colorado River replacement, would affect about 1,655,900 more persons than the historical average, and between 2000-2009 about 2,085,000 more persons. These impacts are about 41.0 and 36.5 percent of the service area's total projected population increases. Table 25 also presents the increase in housing units and required acreages associated with this growth in housing. During the 1980s, Scenario 1 will affect an additional 283,700 housing units, which would require about 42,800 acres. This impact is about 24.8 and 28.7 percent of the service area's total projected housing unit and acreage increases. By 2010, an additional 910,000 housing units would be associated with full SWP deliveries. These housing units would require about 123,800 acres. These impacts are about 36.3 and 38.1 percent of the service area's total projected housing unit and acreage increases.

If future SWP entitlement is used to replace Colorado River supplies after 1990, additional growth above historic levels (1979-1983) would occur under Scenario 1 in all time periods (Table 27). It is estimated that, after allowing for Colorado River replacement, full SWP deliveries between 2000 and 2009 will affect an additional 1,282,200 persons above the historical average, and will affect about 582,400 additional housing units, requiring about 76,300 acres. These impacts are about 22.4, 23.3, and 23.5 percent of the service area's total projected population, housing unit, and acreage increases (Table 28).

Comparisons of historical averages with Scenario 4 indicates that, without any adjustments for loss of Colorado River water, the service area will grow, even if the SWP were to remain at current yield. Even if no additional facilities were added (Scenario 5), some growth is projected to occur, although at lower levels. After adjustment for Colorado River water replacement, growth would still occur in the service area through 2000 under Scenarios 4 and 5, but after 2000, no growth would occur for Scenario 5.

Minimal increases or no increases in SWP deliveries could slow urban expansion into outlying areas within the service area. Historically, urban development in this area has preceded water development. If this trend continues, urban growth could continue, with or without these additional SWP supplies. Forced to seek other supplies, urban water users in this area could divert water now being used to support agricultural production. This change in water use could lead to removal of agricultural lands from production, leaving them more vulnerable to urban uses.

The question of water availability and its association with urban development is being addressed by several of the county governments in the service area. Riverside County, for example, has recommended in its general plan that the development proponent must show that water supplies needed to meet the demands of the development are available. Adopting policies to insure water resources availability prior to actual development can reverse historical trends that allowed development to occur without the water supplies needed to support that development.

In conclusion, urban expansion, including SWP-induced expansion in the Southern California service area, is expected to continue to have some significant environmental effects on land use. These effects would be reduced after 1990 if increased SWP entitlement is used to support existing uses currently associated with Colorado River water. Without adjusting for Colorado River replacement, population growth (and related housing and acreage requirements) associated with the increase in Scenario 1 deliveries between 1980 and 2010 is about 36.5 percent of the total projected population increase over this same period in the Southern California service area. After adjustment for Colorado River replacement, the Scenario 1 increase is reduced to about 22.4 percent of the total projected population increases.

Soils and Geology. It is difficult to predict what type of impact future growth will have on the service area's soil. However, existing soil-associated problems such as erosion, drainage, salinity, toxicity, and compaction are expected to remain and perhaps be greatly magnified. As level farmlands and developable urban lands diminish, marginally suited land with greater soil problems may be developed. With development into the hilly and mountainous regions (for instance, chaparral-covered hillsides), the danger of brush fires will increase, and runoff will also be greater, intensifying erosion and sedimentation. Future developments would also be subject to a number of geological concerns, including lack of stability on hillsides (landslides), seismic rupture, and sand and gravel depletions. Development in the south coastal and inland and desert areas would also subject greater numbers of new residents to flooding hazards.

Future development in significantly hazardous areas is expected to be restricted. At present, general plans are becoming more cognizant of the problems associated with special planning areas, such as mountain and hillside developments. Riverside

County, for example, has developed standards for hillside development that recognize the need for special methods to insure slope stability. With or without additional SWP supplies, urban growth and its impact on soils in the service area will continue.

Vegetation. Future SWP deliveries would indirectly result in the loss of some vegetation, open space, and wildlife habitat. The primary cause of these losses would be urban development, which would not only threaten the natural vegetation in the immediate area but would also threaten surrounding vegetation with with increased fire, slide, and flood hazards.

The impact of future development associated with the SWP would depend on future environmental policies and laws. While continued urban expansion into uncultivated open land can accelerate the change from natural species to replacement species, this process, and the ecological imbalances it creates, can be slowed or even halted by effective environmentally-oriented developmental policies and programs.

Urban expansion in this service area will continue to threaten rare or endangered plants and sensitive plant communities, but the threat will diminish, if current actions to protect these species continue. Several counties within the service area have incorporated programs and standards in their general plans that prevent or mitigate adverse impacts from urban development upon vegetation. These programs and standards provide for plans to preserve and manage vegetation and wildlife, as well as policies that require developers to mitigate the adverse effects of their projects. In addition to policies and programs set forth in the general plans, protection of rare or endangered plant species is also possible through the provisions of the California Environmental Quality Act (CEQA), which requires that, where feasible, significant development impacts be avoided or minimized.

If no additional surface water supplies are made available in the service area (through increases in SWP supplies or other sources), increased reliance on available ground water could further lower ground water levels. This decline could indirectly affect riparian habitats by reducing or degrading the base flows to these areas.

Dwindling urban water supplies may significantly curtail some urban uses. With less water available for landscaping, urban residents may be forced to plant natural landscapes. Development of natural landscaping would encourage residents to use native plants, which are generally better suited for the climatic conditions of the service area.

Wildlife. Pressure for extensive urban growth in the service area is expected to continue. With such growth, many of the remaining areas suitable for wildlife may be affected. Future increases in SWP entitlements to the service area could significantly affect wildlife. After 1990, wildlife impacts associated with SWP deliveries would diminish significantly if SWP water were diverted to present uses associated with Colorado River deliveries. The degree of impact varies with two factors: which scenario is applied and whether SWP water is used as replacement; but some habitat and its associated wildlife are expected to be affected directly by any future urban expansion. Indirect impacts associated with this urban growth will result from diversions of streams for municipal water supplies, increased effluent discharges, and intensified use of remaining open spaces. Some losses, such as those resulting from stream diversions, could be lessened if SWP water were used to replenish these streams directly or to replace diversions. These actions would allow more water to remain in the streams.

Future urban growth in the San Bernardino Mountains and Antelope and Coachella Valleys could affect the rare southern rubber boa, which occurs near Lake Arrowhead, and the endangered Coachella Valley fringe-toed lizard. Urban growth in Coachella Valley in the next 20 years is expected to be significant in or around Palm Springs, Palm Desert, Indio, and Coachella. Much of this growth could encroach on Coachella Valley fringe-toed lizard habitat. Future SWP supplies could accommodate some of the economic growth expected in this region. When this growth occurs, however, successful methods to protect the lizard might have been implemented. Riverside County presently has a plan to protect and preserve the endangered lizard's habitat. An example of this preservation effort is the Coachella Valley Ecological Reserve, established to protect critical habitat essential to the lizard's survival.

Future urban and industrial growth accommodated by future SWP supplies in this service area could also displace some habitat for the rare Mohave ground squirrel and the rare Stephen's kangaroo rat. The amount of habitat potentially displaced by this growth is difficult to determine. It is possible that, by the time SWP supplies can support additional growth, essential habitat for these species will have been identified and/or set aside in special reserves. Suitable habitat for the Stephen's kangaroo rat is known to exist at the Lake Matthews Ecological Reserve and at several military land holdings such as the Camp Pendleton Marine Corps base, Seal Beach Naval Weapons Station-Fallbrook Annex, and March Air Force Base.

Riparian habitat along the Santa Ana and South Fork Kern Rivers are known to support sparse populations of the yellow-billed cuckoo. Future deliveries and use of SWP municipal and industrial water are not expected to impact this species' remaining habitat. The Santa Ana River habitat is located within the floodplain of the river and the Prado Flood Control Basin. San Bernardino and Riverside Counties have designated this area as a conservation and open space zone in their general plans. The Wildlife Conservation Board has acquired 1,300 acres of riparian habitat along the Riverside County portion of the Santa Ana River.

Increasing urban development in the Antelope Valley, Lucerne Valley, and Mojave River Valley will probably displace some Mohave ground squirrel habitat. Surveys have been conducted by the Department of Fish and Game and the U.S. Bureau of Land Management to determine the extent of the ground squirrel's range. However, more studies are needed to determine the effects of urban and agricultural development on this animal.

If SWP supplies to the service area are less than the full contractual amount (Scenarios 2-5), other means to maintain existing supplies and to replace Colorado River water will need to be sought. Some forms of water augmentation to make up for lost entitlements may have more serious environmental consequences than would using imported SWP water.

Replacing surface water deliveries with ground water extractions would lower water tables and, in some cases, reduce instream flows. Additional diversions from streams to supplement lowered entitlements would also reduce instream flows, which would lessen the habitat values of both the stream and its environs. Reduced instream flows can increase sediment deposition and concentrate pollutants from both urban and agricultural users, adversely affecting fish. The probability increases that, as water entitlements from the SWP and the Colorado River decrease, new local surface reservoirs will be built to replace these water supplies. More wildlife habitat may be lost through this activity than through completion of the SWP.

Water Quality. If SWP water is used to replace lost Colorado River entitlement, water quality in the service area would be improved. Existing Colorado River water must be blended with better quality water before it is within standards recommended by the State of California for safe drinking. Blending Colorado River water with SWP water improves taste and extends the useful lifetimes for appliances and fixtures. Replacing Colorado River water presently being used to recharge ground water basins with SWP water will improve water quality in these recharge basins.

Increased deliveries (Scenario 1) to the Southern California service area would expose a greater population to risks associated with trihalomethane (THM) and asbestos in SWP water. Without additional treatment or the construction and operation of a Delta facility, levels of THM in drinking water will continue to exceed federal standards. Asbestos currently occurs in high concentrations in the California Aqueduct. While there are presently no health standards for asbestos in drinking water, hearings to set standards are in progress. In addition, DWR is investigating the ability of water users to meet the range of water quality standards for asbestos that may be imposed.

Urban expansion into aquifer recharge areas (highly permeable soils located over a viable aquifer) can affect ground water supply and quality. In Los Angeles County, approximately 6,500 acres of potential urban lands are located in aquifer recharge areas. About 58 percent of these areas exist in the southern portion of the county, in the east San Gabriel Valley and San Fernando areas, and 37 percent are situated in Antelope Valley. Development in these areas would reduce potential ground water recharge.

If additional SWP supplies were not available for existing and future urban uses, greater reliance may be placed on ground water, thus increasing the likelihood of ground water basin overdrafts and salt-water intrusion along the coast. Some surface water supplies that require better quality water for blending (for instance, the Colorado River) may not meet standards, should additional high quality water (SWP supplies) be unavailable. Greater dependence on local sources of water supply to augment Scenario 4 or 5 SWP supplies could result in new impoundments on local streams or enlargement of existing reservoirs. This water development could destroy wildlife habitat in the project area, and change vegetation, fish, and wildlife downstream from the project. If no alternative sources of water were available, curtailment of local growth would reduce some urban water quality problems, while increasing others.

To prevent or lessen the adverse effects of urban expansion on water quality in Los Angeles County, the county general plan includes policies to protect and preserve ground water recharge and watershed areas, promote water conservation programs, conserve storm and reclaimed water, increase storage of potable water through the use of spreading grounds, and promote population growth in ways that are consistent with water availability. These policies are also designed to encourage the maintenance, management, and improvement of imported water supplies such as those of the SWP, as well as ground water, natural runoff, and ocean water.

It is the overall responsibility of the State Water Resources Control Board and the Regional Water Quality Control Boards to regulate the activities and factors that may affect the quality of water of the State to ensure attainment of the highest water quality which is reasonable, considering all present and future water demands made on this water and the beneficial uses involved. The Regional Water Quality Control Boards in the service area are responsible for preparing and maintaining regional Water Quality Control Plans. These plans are approved and periodically amended by the regional board, the State board, and the Environmental Protection Agency. Generally, these plans contain water quality objectives, adopted standards, and water quality data for the surface and ground water basins in the service area. The plans adopted for the service area assume full entitlement deliveries (Scenario 1) from the SWP. Some of the adverse water quality problems that might occur in the service area can be mitigated by the implementation of these plans.

Air Quality. Air quality impacts are caused by emissions from automobiles and industrial and commercial developments. Increasing SWP water supplies in the Southern California service area will continue to have indirect effects upon air quality after 2010. These effects will result from growth that could be supported by increased SWP supplies.

To control the potential adverse air quality impacts of future growth, the South Coast Air Quality Management District and the Southern California Association of Governments have developed an Air Quality Management Plan (AQMP) for the basin. This plan, revised in 1982, accounts for future growth in the basin (including growth accommodated by future SWP water) and recommends control measures necessary for attainment of federal air quality standards. The AQMP for this basin recommends implementing five basic types of control measures: stationary source controls (petroleum production and distribution), transportation measures (system design improvements), mobile technological controls (emission controls), energy conservation measures (reducing demand for power generation), and land use measures (measures to reduce the use of the automobile).

The AQMP's proposed land use policies encourage workers to live nearer their workplaces, increase ride-sharing, and use bicycles, where possible. The plan also calls for a ban on gasoline-powered lawn blowers and restrictions on gasoline refinery heaters, boilers, dry cleaners, air lines, and aerosol products. Long-range tactics include construction of rapid transit systems and the development and use of synthetic fuels and electric cars.

In addition to regional and basinwide air pollution control plans, counties have also recognized a reponsibility for controlling air pollution and have set forth policies and criteria to reduce the potential for air quality impacts.

Adopting these plans and policies and implementing programs to maintain State and federal standards will result in a general improvement of air quality. The impact of future growth supported by SWP water would depend on the effectiveness of these plans.

Table 16: THREATENED, RARE, OR ENDANGERED SPECIES, SOUTHERN CALIFORNIA CALIFORNIA SERVICE AREA

Scientific Name	Common Name	Status 1/
PLANTS		
Acanthomintha ilicifolia	San Diego thornmint	SE
Astragalus magdalenae var. peirsonii	Pierson's milk-vetch	SE
Broadiaea filifolia	Threadleaf broadiaea	SE
Calochortus dunnii	Dunn's Mariposa lily	SR
Castilleja gleasonii	Mt. Gleason indian paint-brush	SR
Caulanthus stenocarpus	Slender-pod squaw-cabbage	SR
Cercocarpus traskiae	Island Mtn. mahogany	SE
Chorizanthe orcuttiana	Kearney Mesa spine flower	SE
Cordylanthus maritimus ssp. maritimus	Salt marsh bird's beak	SE
Downingia concolor var. brevior	Cuyamaca Lake downingia	SE
Dudleya cymosa spp. marcescens	Santa Monica Mts. live-forever	SR
Dudleya stolonifera	Laguna Beach live-forever	SR
Eriogonum crocatum	Ventura buckwheat	SR
Eryngium aristulatum var. parishii	San Diego coyote thistle	SE
Hemizonia conjungens	Otay tarplant	SE
Machaeranthera lagunensis	Laguna Mtn. aster	SR
Monardella linoides ssp. viminea	Willowy San Diego mint	SE
Nolina interrata	Dehesa beargrass	SE
Orcuttia californica	California Orcutt grass	SE
Pogogyne abramsii	San Diego mesa mint	SE
Thelypodium stenopetalum	Slender-petaled thelypodium	SE

Scientific Name	Common Name	Status
FISH		
Gasterosteus aculeatus williamsoni	Unarmored threespine stickleback	SE, FE
Gila bicolor mohavensis	Mohave chub	SE, FE
AMPHIBIANS		
Batachgoseps aridus	Desert slender salamander	SE, FE
REPTILES		
Charina bottae umbratica	Southern rubber boa	SR
Uma inornata	Coachella fringe-toed lizard	SE, FT
BIRDS		
Coccyzus americanus occidentalis	California yellow-billed cuckoo	SR
Falco peregrinus anatum	American peregrine falcon	SE, FE
Gymnogyps californianus	California condor	SE, FE
Haliaeetus leucocephalus	Bald eagle	SE, FE
Laterallus jamaicensis coturniculus	California black rail	SR
Passerculus sandwishensis	Belding's savannah sparrow	SE
Pelecanus occidentalis californicus	California brown pelican	SE, FE
Rallus longirostris levipes	Light-footed clapper rail	SE, FE
Sterna albifrons browni	California least tern	SE, FE
Vireo bellii pusillus	Least Bell's vireo	SE
MAMMALS		
Dipodomys stephensi	Stephen's kangaroo rat	SR
Ovis canadeasis cremnobates	Peninsular bighorn sheep	SR
Spermophilus mohavensis	Mohave ground squirrel	SR

1/ Status: SR - State listed rare species; SE - State listed endangered species
FE - Federally listed endangered species; FT - Federally listed threatened species

Source: California Department of Fish and Game. At the Crossroads, 1980, and "Designated Endangered or Rare Plants", August 1982 (typewritten).

Table 17: Population of the
Southern California Service Area
1980-2010
(thousands)

SWP Contractors	1980	1990	2000	2010
Antelope Valley-East Kern Water Agency	103.2	156.8	208.4	219.5
Castaic Lake Water Agency	78.5	115.7	124.8	130.0
Coachella Valley Water District	85.9	122.7	152.8	182.4
Crestline-Lake Arrowhead Water Agency	15.2	18.9	22.2	23.4
Desert Water Agency	48.7	74.7	95.9	114.5
Littlerock Creek Irrigation District 1/	-	-	-	-
Mojave Water District	130.6	179.6	220.8	264.6
Palmdale Water District	23.0	33.5	46.5	48.4
San Bernardino Valley Municipal Water District	356.4	510.0	600.4	719.5
San Gabriel Valley Municipal Water District	156.9	164.1	167.9	175.0
San Gorgonio Pass Water Agency	34.7	46.0	64.0	77.6
Metropolitan Water District of Southern California	11,977.6	13,811.0	15,248.5	16,630.8
Ventura County Flood Control & Water Conservation District 2/	185.1	237.1	286.7	324.8
Total	13,195.8	15,470.1	17,238.9	18,910.5

Source: Department of Water Resources, State Water Project; Recommended Water Management Plan for the Metropolitan Water District of Southern California, 1982.

1/ Included in Antelope Valley-East Kern Water Agency.

2/ Excludes Metropolitan Water District of Southern California portions.

Table 18: Water Supplies in the Southern California Service Area[1/]
1980-2010
(thousands of acre-feet)

Water Source	1980	1990	2000	2010
Local Ground Water	1,155.1	1,155.1	1,155.1	1,155.1
Local Surface Water	159.2	159.2	159.2	159.2
Waste Water Reclamation	64.0	150.3	280.2	356.6
Los Angeles Aqueduct	467.0	467.0	467.0	467.0
Colorado River	1,480.0	718.0	686.0	686.0
SWP, Full Entitlement	1,276.8	2,417.1	2,426.7	2,426.7
SWP, w/o Additional Facilities	(1,276.8)	(1,200.0)	(1,090.0)	(1,090.0)
Total, Full Entitlement	4,602.1	5,066.7	5,174.2	5,250.6
Total, w/o Additional Facilities	(4,602.1)	(3,849.6)	(3,837.5)	(3,913.9)

1/ Excludes Ventura County FCWCD. Source: State Water Project; Recommended Water Management Plan for The Metropolitan Water District of Southern California, 1982. Information was also obtained from other SWP water management plans published under similar titles for the following agencies: Antelope Valley-East Kern W. A., Castaic Lake W. A., Coachella Valley W. D., Crestline-Lake Arrowhead W. A., Littlerock Creek I. D., Mojave W. D., Palmdale W. D., San Bernardino Valley Municipal W. D., San Gabriel Valley Municipal W. D., and San Gorgonio Pass W. A.

Table 19: Water Demand in the Southern California Service Area[1/]
1980-2010
(thousands of acre-feet)

Water Demand	1980	1990	2000	2010
Urban	2,987.4	3,636.6	4,202.7	4,734.6
Agricultural	1,224.0	1,176.4	1,127.7	1,054.5
Conservation (Urban)	-	(270.7)	(457.2)	(553.2)
Total	4,211.4	4,542.3	4,873.2	5,235.9

1/ Excludes Ventura County FCWCD. Source: State Water Project; Recommended Water Management Plan for The Metropolitan Water District of Southern California, 1982. Information was also obtained from other SWP water management plans published under similar titles for the following agencies: Antelope Valley-East Kern W. A., Castaic Lake W. A., Coachella Valley W. D., Crestline-Lake Arrowhead W. A., Littlerock Creek I. D., Mojave W. D., Palmdale W. D., San Bernardino Valley Municipal W. D., San Gabriel Valley Municipal W. D., and San Gorgonio Pass W. A.

Table 20: Average Annual Direct, Indirect, and Induced Income Impacts Supported by SWP Firm Deliveries
Southern California Service Area
(billions of 1982 dollars)

Impacts Between Scenarios	1980-1989		1990-1999		2000-2009		2010-2019		2020+	
	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced
Scenarios 1 and 2	$0	$0	$0	$0	$0	$0	$0.7	$2.4	$3.0	$10.0
Scenarios 2 and 3	0	0	0	0	0.1	0.4	2.7	9.3	2.9	9.8
Scenarios 3 and 4	0	0	1.4	4.8	3.3	11.3	3.3	11.3	3.2	10.8
Scenarios 4 and 5	0	0	1.0	3.3	1.4	4.9	2.9	9.8	3.3	11.4
Total Impact	0	0	2.4	8.1	4.8	16.6	9.6	32.8	12.4	42.0

Impacts are what would occur during an average year per decade; they are not decade totals.

Table 21: Average Annual Direct, Indirect, and Induced Employment Impacts Supported by SWP Firm Deliveries
Southern California Service Area
(thousands of person-years)

Impacts Between Scenarios	1980-1989		1990-1999		2000-2009		2010-2019		2020+	
	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced
Scenarios 1 and 2	0	0	0	0	0	0	19.7	117.7	79.2	473.3
Scenarios 2 and 3	0	0	0	0	5.3	31.6	75.6	451.9	75.9	453.6
Scenarios 3 and 4	0	0	36.4	217.6	88.5	529.0	88.8	530.6	88.6	529.5
Scenarios 4 and 5	0	0	25.5	152.4	38.1	227.7	76.0	454.3	88.6	529.5
Total Impact	0	0	61.9	370.0	131.9	788.3	260.1	1,554.5	332.3	1,985.9

Impacts are what would occur during an average year per decade; they are not decade totals.

Table 22: Average Annual Population Impact Supported by SWP Firm Deliveries
Southern California Service Area
(thousands of persons)

Impacts Between Scenarios	1980-1989	1990-1999	2000-2009	2010-2019	2020+
Scenarios 1 and 2	0	0	0	207.2	833.3
Scenarios 2 and 3	0	0	55.1	798.1	798.1
Scenarios 3 and 4	0	402.0	931.7	931.0	931.5
Scenarios 4 and 5	0	281.3	400.1	799.2	931.9
Total Impact	0	683.3	1,386.9	2,735.5	3,494.8

Impacts are what would occur during an average year per decade; they are not decade totals.

Table 23: Average Annual Housing Unit Impact Supported by SWP Firm Deliveries
Southern California Service Area
(thousands of units)

Impacts Between Scenarios	1980-1989 Total	1980-1989 Single Family	1980-1989 Multiple Family	1990-1999 Total	1990-1999 Single Family	1990-1999 Multiple Family	2000-2009 Total	2000-2009 Single Family	2000-2009 Multiple Family
Scenarios 1 and 2	0	0	0	0	0	0	0	0	0
Scenarios 2 and 3	0	0	0	0	0	0	22.5	13.1	9.4
Scenarios 3 and 4	0	0	0	164.9	99.7	65.2	380.1	221.4	158.7
Scenarios 4 and 5	0	0	0	115.4	69.7	45.7	163.3	95.1	68.2
Total Impact	0	0	0	280.3	169.4	110.9	565.9	329.6	236.3

Impacts Between Scenarios	2010-2019 Total	2010-2019 Single Family	2010-2019 Multiple Family	2020+ Total	2020+ Single Family	2020+ Multiple Family
Scenarios 1 and 2	84.6	49.3	35.3	340.0	198.1	141.9
Scenarios 2 and 3	325.7	189.7	136.0	325.7	189.7	136.0
Scenarios 3 and 4	379.9	221.3	158.6	380.1	221.3	158.8
Scenarios 4 and 5	326.2	189.9	136.3	380.3	221.5	158.8
Total Impact	1,116.4	650.2	466.2	1,426.1	830.6	595.5

1/ Impacts represents what would occur during an average year per decade; they are not decade totals.

Table 24: Total Projected Population, Housing Units, and Acreage Requirements
Southern California Service Area

	1980	1990	2000	2010
Population				
(thousands of persons)	13,195.8	15,470.1	17,238.9	18,910.5
Housing Units				
(thousands of units)				
Single Family	3,209.5	3,823.0	4,211.0	4,543.1
Multiple Family	1,800.9	2,331.9	2,644.5	2,970.9
Total Units	5,010.4	6,154.9	6,855.5	7,514.0
Acreage Requirements				
(thousands of acres)				
Single Family 1/	641.9	764.6	842.2	908.6
Multiple Family 2/	90.0	116.6	132.2	148.5
Total Acres	731.9	881.2	974.4	1,057.1

1/ Assumes 1 acre could accommodate 5 single family units

2/ Assumes 1 acre could accommodate 20 multiple family units.

Table 25: SWP Impacts Above Historical Activity, Without Colorado River Replacement, Southern California Service Area 1/

	1979-1983 2/ SWP Annual Average	1980-1989 Scenario 1	1980-1989 Scenario 4	1980-1989 Scenario 5	1990-1999 Scenario 1	1990-1999 Scenario 4	1990-1999 Scenario 5	2000-2009 Scenario 1	2000-2009 Scenario 4	2000-2009 Scenario 5
Population (thousands of persons)	1,916.1	752.0	752.0	752.0	1,655.9	1,253.9	972.6	2,085.0	1,098.2	698.1
Housing Units (thousands of units)										
Single Family	445.4	174.8	174.8	174.8	440.0	340.3	270.6	505.5	271.0	175.9
Multiple Family	277.3	108.9	108.9	108.9	302.7	237.5	191.8	404.5	236.4	168.2
TOTAL	722.7	283.7	283.7	283.7	742.7	577.8	462.4	910.0	507.4	344.1
Acreage Requirements (thousands of acres)										
Single Family 3/	89.1	34.9	34.9	34.9	88.0	68.0	54.1	101.1	54.2	35.2
Multiple Family 4/	13.9	7.9	7.9	7.9	17.6	14.3	12.1	22.7	14.3	10.9
TOTAL	103.0	42.8	42.8	42.8	105.6	82.3	66.2	123.8	68.5	46.1

1/ These impacts are the incremental changes in historical SWP activity caused by SWP scenario deliveries for each decade. Positive numbers represent an incremental increase in SWP historical activity (growth), while negative numbers (in parentheses) represent incremental decreases in SWP historical activity.

2/ These estimates are the total levels of socioeconomic activity affected by SWP average annual deliveries over the period 1979-1983.

3/ Assumes 1 acre could accommodate 5 single family units.

4/ Assumes 1 acre could accommodate 20 multiple family units.

Table 26: SWP Impact As Percentage of Total Projected Service Area Increase, Without Colorado River Replacement,[1/]
Southern California Service Area

	1980-1989			1990-1999			2000-2009		
	Scenario 1	Scenario 4	Scenario 5	Scenario 1	Scenario 4	Scenario 5	Scenario 1	Scenario 4	Scenario 5
Population	33.1%	33.1%	33.1%	41.0%	31.0%	24.1%	36.5%	19.2%	12.2%
Housing Units									
Single Family	28.5%	28.5%	28.5%	43.9%	34.0%	27.0%	37.9%	20.3%	13.2%
Multiple Family	20.5	20.5	20.5	35.9	28.2	22.7	34.6	20.2	14.4
OVERALL HOUSING	24.8	24.8	24.8	40.3	31.3	25.1	36.3	20.3	13.7
Acreage Requirements									
Single Family	28.4%	28.4%	28.4%	43.9%	33.9%	27.0%	37.9%	20.3%	13.2%
Multiple Family	29.7	29.7	29.7	41.7	33.9	28.7	38.8	24.0	18.6
OVERALL ACREAGE	28.7	28.7	28.7	43.5	33.9	27.3	38.1	21.1	14.2

1/ This compares the incremental percentage change in socioeconomic activity caused by SWP deliveries with the total incremental change projected in Table 24. Positive numbers represent an incremental percentage increase in SWP historical activity (growth), while negative numbers (in parentheses) represent incremental percentage decreases in SWP historical activity.

Table 27: SWP Impacts Above Historical Activity, With Colorado River Replacement,[1]
Southern California Service Area

	1979-1983[2] SWP Annual Average	1980-1989			1990-1999			2000-2009		
		Scenario 1	Scenario 4	Scenario 5	Scenario 1	Scenario 4	Scenario 5	Scenario 1	Scenario 4	Scenario 5
Population (thousands of persons)	1,916.1	752.0	752.0	752.0	813.5	411.5	130.2	1,282.2	295.4	(104.7)
Housing Units (thousands of units)										
Single Family	445.4	174.8	174.8	174.8	231.2	131.5	61.8	314.7	80.2	(14.8)
Multiple Family	277.3	108.9	108.9	108.9	165.9	100.7	55.0	267.7	99.6	31.4
TOTAL	722.7	283.7	283.7	283.7	397.1	232.2	116.8	582.4	179.8	16.6
Acreage Requirements (thousands of acres)										
Single Family[3]	89.1	34.9	34.9	34.9	46.2	26.3	12.4	62.9	16.0	(3.0)
Multiple Family[4]	13.9	7.9	7.9	7.9	8.3	5.0	2.8	13.4	5.0	1.6
TOTAL	103.0	42.8	428	42.8	54.5	31.3	15.2	76.3	21.0	(1.4)

1/ These impacts are the incremenal changes in historical SWP activity caused by SWP scenario deliveries for each decade. Positivite numbers represent an incremental increase in SWP historical activity (growth), while negative numbers (in parentheses) represent incremental decreases in SWP historical activity.

2/ These estimates are the total levels of socioeconomic activity affected by SWP average annual deliveries over the period 1979-1983.

3/ Assumes 1 acre could accommodate 5 single family units.

4/ Assumes 1 acre could accommodate 20 multiple family units.

Table 28: SWP Impact As Percentage of Total Projected Service Area Increase, With Colorado River Replacement,[1/] Southern California Service Area

	1980-1989			1990-1999			2000-2009		
	Scenario 1	Scenario 4	Scenario 5	Scenario 1	Scenario 4	Scenario 5	Scenario 1	Scenario 4	Scenario 5
Population	33.1%	33.1%	33.1%	20.1%	10.2%	3.2%	22.4%	5.2%	(1.8%)
Housing Units									
Single Family	28.5%	28.5%	28.5%	23.1%	13.1%	6.2%	23.6%	6.0%	(1.1%)
Multiple Family	20.5	20.5	20.5	19.6	11.9	6.5	22.9	8.5	2.6
OVERALL HOUSING	24.8	24.8	24.8	21.5	12.6	6.3	23.3	7.2	0.7
Acreage Requirements									
Single Family	28.4%	28.4%	28.4%	23.1%	13.1%	6.2%	23.6%	6.0%	(1.1%)
Multiple Family	29.7	29.7	29.7	19.6	11.8	6.6	22.9	8.5	2.7
OVERALL ACREAGE	28.7	28.7	28.7	22.5	12.9	6.3	23.5	6.5	(0.4)

1/ This compares the incremental percentage change in socioeconomic activity caused by SWP deliveries with the total incremental change projected in Table 24. Positive numbers represent an incremental percentage increase in SWP historical activity (growth), while negative numbers (in parentheses) represent incremental percentage decreases in SWP historical activity.

CHAPTER III. SAN JOAQUIN VALLEY SERVICE AREA

Description and Location

The San Joaquin Valley service area, which occupies a nearly level plain in the southern part of the San Joaquin Valley, is situated primarily in Kern and Kings Counties and includes a small portion in western Stanislaus County. Total SWP entitlement deliveries to this service area are projected to reach 1,355,000 acre-feet per year after 1990, with about 1,226,300 acre-feet projected for agricultural use.

The largest SWP contractor in the service area is the Kern County Water Agency (KCWA), with about 85 percent of the total service area entitlement. KCWA wholesales the SWP supplies to its 16 member units (Table 29). (All tables referred to in this chapter appear at the end of this chapter.) SWP contractors in Kings County include Devil's Den Water District (of which a small portion is in Kern County), Dudley Ridge Water District, Empire West Side Irrigation District, Kings County Water District, and Tulare Lake Basin Water Service District. Oak Flat Water District is situated in Stanislaus County.

The San Joaquin Valley service area occupies one of the most productive agricultural regions in California. However, part of the area is situated on the west side of the valley, where ground water supplies are of poor quantity and quality and local surface streams are practically nonexistent. Before the delivery of water by the State Water Project, much of the land was uncultivated. With SWP water, a great deal of it has been converted to farmland. The climate is conducive to the production of a wide variety of orchard, vineyard, and truck and field crops.

Figure 6 shows the location of the San Joaquin Valley service area in the State. Figure 7 depicts the service area in detail.

Environmental and Socioeconomic Profile

Physical and Biological Environment

The following description of the San Valley Joaquin service area's physical and biological environment includes such factors as climate, drainage, vegetation, wildlife, rare and endangered species, and air quality.

Climate. The climate of the service area can be characterized as Mediterranean. Summers are hot and dry, with daily high temperatures averaging over 90°F. Mild winters allow for a long growing season that averages about 300 days per year. While rainfall in the valley generally ranges from 8 to 12 inches per year, annual rainfall amounts of less than 5 inches in the southern portion are common. Winds blow predominately from the northwest. This trend

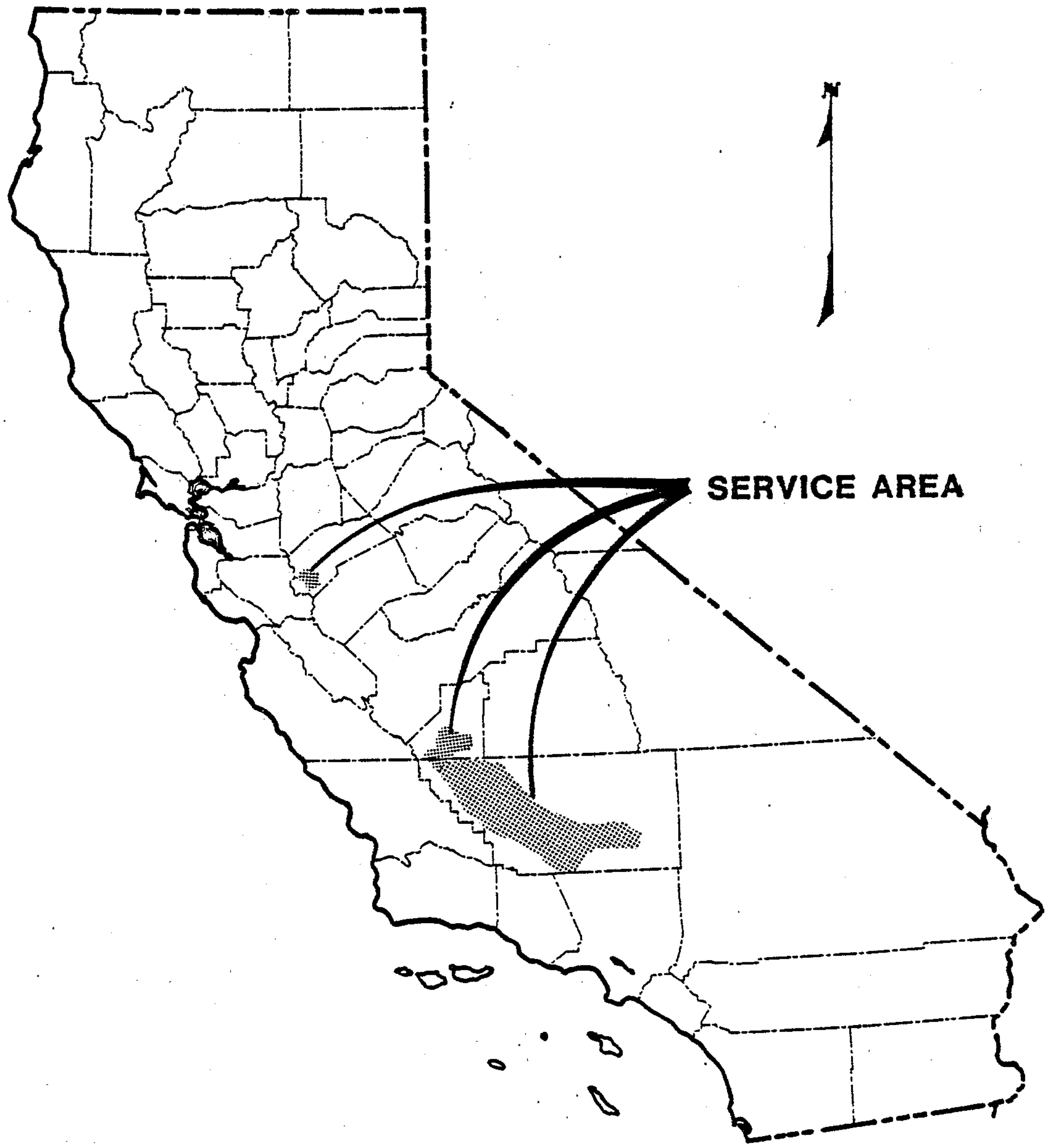
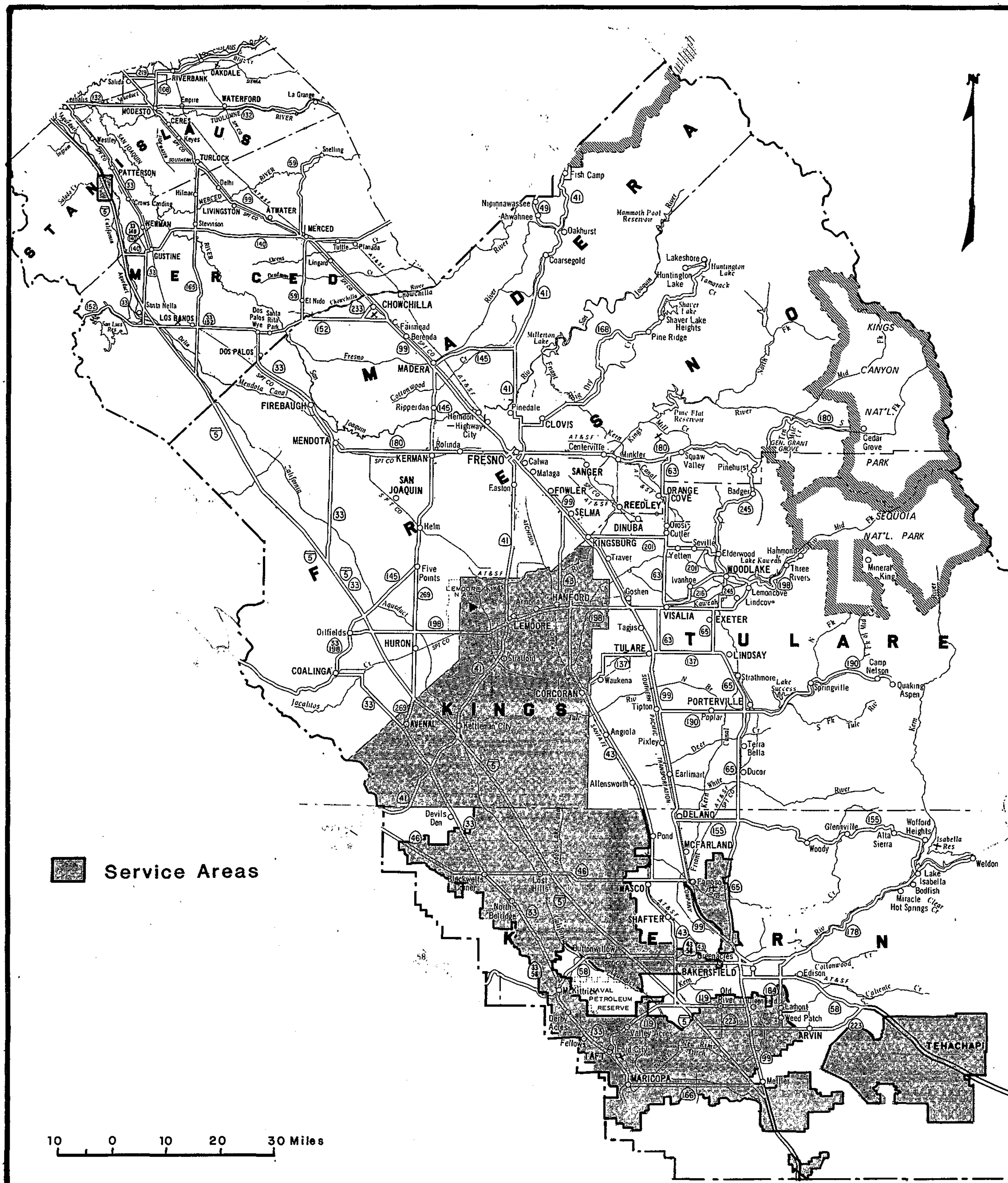


Figure 6.
SAN JOAQUIN VALLEY SWP SERVICE AREA
STATE WATER PROJECT CONTRACTORS

Figure 7. SAN JOAQUIN VALLEY SERVICE AREA



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can be reversed, however, when Pacific storm systems move into the valley. Heavy tule fog is common in the service area during winter.

Drainage. Most of the service area lands are situated on the relatively flat valley floor or the gently sloping Coast Range foothills.

The two major river drainages in the service area are the Kings in King County and the Kern in Kern County. Intermittent streams in or near the service area include the Poso, Caliente, and Tejon Creeks in Kern County; the Kaweah and Tule Rivers in Kings County; and the Crow and Salado Creeks in Stanislaus County.

Drainage problems occur throughout the valley. They are especially significant in the western portion of the service area. Faulty drainage can cause salt build-up and waterlogging of the soil, thus limiting crop selection and production. The drainage problem is increasing, and the acreage of land classed as "poorly drained" is expected to more than double by 2000.

Vegetation. Much of the native vegetation in the service area has been replaced by introduced species or disturbed by cultivation or grazing. Major natural vegetation classes found within the valley include grassland, sagebrush shrub, coastal shrub, and hardwood forest-woodland.

Annual grasslands occur throughout the service area, and are usually found between urban/agricultural developments and the foothill woodlands. Among the annual grasses and forbs, a number of vernal pool species can be found in the valley.1/ Plant species usually form concentric circles around these pools. The perennial grasses are dominated by saltgrasses that occur on alkaline and saline soils in the service area. The presence of saltgrass indicates alkali sinks.

Cattail-sedge species such as tule cattail and spike rush occur throughout the service area in fresh and brackish marshes, farm ponds, and ditches. Extensive drainage of marsh areas has significantly reduced the historical populations of these species.

In the sagebrush shrub group, the dominant shrub is saltbush. Saltbush and associated species are alkali-tolerant and usually located in or near sinks or alkali flats. The coastal scrub community consists of sagebrush, buckwheat, and saltbrush,

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1/ A vernal pool is a seasonal pool underlain by restricting surface or subsurface clays. It is supplied by snowmelt or floodwater during the spring but is dry the rest of the year.

which is usually found on dry slopes and alluvial fans in the service area.

The hardwood forest-woodland community within the service area is composed primarily of blue, valley, and interior live oaks. Cottonwoods, usually found with valley oaks near streams, are also present. The blue oaks are found in the foothills bounding the western edge of the service area, while interior live oaks are scattered throughout the service area.

Wildlife. The wildlife populations of the service area remain extremely diversified, despite the conversion of much of the area to agricultural uses.2/ Sizable populations of wildlife can be found in the fringe areas of the service area. Most native fish populations, however, have been eliminated by drainage projects and modifications of natural water courses. They are now confined to farm ponds, drainage canals, and aqueducts.

The wildlife habitat types found in the service area can be broadly defined as valley grasslands, brushlands, woodlands, riparian/aquatic, agricultural lands, and urban lands.

The valley grassland community that historically dominated the region still supports numerous wildlife species. Agricultural conversions and other land use practices have reduced the amount and wildlife value of the native grassland habitat found on the valley floor.

Several wildlife species have adapted to the conversion of the grassland community to cultivated lands. These converted lands generally have large rodent populations that provide prey for raptors and other wildlife that include rodents in their diet. Other species that have adapted to an agricultural environment include pine gopher snakes, brush rabbits, beechy ground squirrels, white-crowned sparrows, mourning doves, American goldfinches, and house finches.

With the exception of the Kings River drainage, riparian habitat is sparse in the service area because of the intermittent nature of most streams. Most low-lying areas collect agricultural drainage water that supports a variety of aquatic plants and a number of marsh and water-associated wildlife. Migratory waterfowl utilize open pastures, harvested fields, and the Goose and Buena Vista Lakes for fall and winter feedings.

Aquatic environments in the service area support populations of catfish, bluegill, and largemouth bass. These warmwater game fish are found in major drainages such as the Kings,

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2/ Native habitat on the San Joaquin Valley is estimated to have disappeared at a yearly rate of 42,247 acres from 1974 to 1977.

Kaweah, and Tule Rivers, and in canals, small ponds, and reservoirs.

Coldwater game species such as rainbow and brown trout are found in some valley canals that provide marginal habitat for these species. These water bodies also contain nongame fish species such as hitch, hardhead, Sacramento sucker, carp, golden shiner, and mosquitofish.

Rare and Endangered Species. Two State-listed rare and two endangered plant species probably exist within the service area boundaries (Table 30). The rare Greene's Orcutt grass is an annual found in moist, open places in Kern and Stanislaus County grasslands. The two endangered grasses, San Joaquin Valley Orcutt grass and Colusa grass, are both found in the grasslands of Stanislaus County. The rare shrub, Red Rock tar plant, known to occur only in the Red Rock Canyon area of Kern County, may also be present in the service area.

There are no known rare or endangered fish species in the service area. Rare or endangered wildlife that may occur in or near the service area are listed in Table 30.

The southern rubber boa is known to occur in the southwestern portion of Kern County. This species is believed to have always had a limited distribution.

The blunt-nosed leopard lizard's native habitat has been reduced considerably by agricultural land conversion, and the species is now limited to scattered locations in the valley foothills and the Carrizo Plains.

The giant garter snake is found in permanent fresh-water bodies (tule-cattail marshes, streams, and sloughs with mud bottoms).

The Tehachapi slender salamander lives in rock talus and under fallen logs in foothill woodlands, usually on north-facing slopes. This species has been collected from several areas in the Piute and Tehachapi Mountains southeast of Bakersfield.

The south fork of the Kern River is the only place in the service area where the California yellow-billed cuckoo is known to breed. Native riparian habitat has been reduced by rapid land and water use changes.

Fewer than 30 California condors are believed to remain. Population size and range have been diminished by pesticide contamination, habitat changes, human disturbance, and its inability to reproduce successfully. The condors' current range has been reduced to the mountains and foothills bordering the San Joaquin Valley.

The bald eagle once nested throughout much of California; however, more recently its population size and range have been diminished by pesticide toxicity, human disturbance, and a reduction in nesting sites. The bald eagle does not nest in the service area, but it may occasionally forage there.

The San Joaquin antelope squirrel occupies about 20 percent of its original range in the central and western San Joaquin Valley.

The giant kangaroo rat occupies a narrow strip along the southwestern margin of the San Joaquin Valley. Habitat loss has been caused by agricultural cultivation, trampling of the land by cattle, and wide use of rodenticides.

Loss of San Joaquin kit fox habitat caused by intensive agricultural activity has practically eliminated this subspecies of kit fox from its former range in Kern and Kings Counties.

Air Quality. The San Joaquin Valley service area is situated within the San Joaquin Valley Air Basin. Stanislaus, Kings, and Kern Counties have been designated by the California Air Resources Board and the U.S. Environmental Protection Agency as nonattainment areas for ozone and total suspended particulates (areas not currently attaining the National Ambient Air Quality Standards). In addition, Kern County has been designated as a nonattainment area for carbon monoxide.

Local air quality is affected by local emissions of primary pollutants added to the ambient air quality in the region. Suspended particulate matter (dust) generated primarily from agricultural activities is a serious problem in this service area.

Economic Activity

Kern County's two major industries are mining and agriculture. In 1979, total mineral production was valued at more than $2.4 billion. Petroleum production accounted for more than 79 percent of this amount, with the production of more than 193 million barrels of oil valued at $1.9 billion. Oil production in the county is expected to increase during the 1980s.

In 1980, Kern County ranked third among California's leading agricultural counties, with gross farm receipts of more than $1.27 billion. During 1980, Kern County led all other counties in the State in the production of shelled almonds, carrots, garlic, onions, spring potatoes, wool, and sheep. The leading farm commodity is cotton, which accounts for almost half the county's harvested acreage. Grapes rank second in agricultural value, followed by almonds.

Total wage and salary employment in Kern County is expected to exceed 186,000 jobs by 1985, a 15-percent increase over 1980. Agricultural employment, which accounts for about 20 percent of total wage and salary employment, is also expected to grow during the 1980s. In 1978, the mining sector employed about 7 percent of the total wage and salary work force; employment in this sector is expected to increase in the 1980s, but at a slower pace. During the 1970s, the percentage of workers employed in manufacturing fell slightly, but substantial increases occurred in petroleum refining. Significant employment increases are expected in the following sectors: services; trade; finance; insurance and real estate; and transportation, communications, and utilities.

Kings County's economic growth over the past decade was more moderate than that in other areas of the San Joaquin Valley. The greatest activity took place in agriculture and retail trade. Farming gross receipts exceeded $635 million in 1980, an 18-percent increase over the 1970s. Cotton, milk, cattle, and alfalfa are the county's leading agricultural products, accounting for nearly three-fourths of the total 1980 farm revenue.

Kings County's retail trade is supported by tourism and increased spending by local consumers. Large numbers of tourists pass through the county, either enroute between Northern and Southern California, or traveling to the recreational areas of the Sierra Nevada.

In 1980, approximately 368,150 acres were irrigated with SWP supplies in the San Joaquin Valley service area. The distribution of these acres by crop type and county is shown in Table 31. Field crops composed the largest portion of the total acreage, with 269,740 acres; the major crop was cotton, with 185,694 acres. Table 32 compares the 1980 acreages supported with SWP supplies with the total acreages for the San Joaquin Valley and the State.

Population

Kern County's population in 1980 is estimated to have been about 405,600. The Department of Finance projects a population of about 504,300 by 1990, nearly a 25-percent increase. The Department of Water Resources predicts that the county's population will reach more than 580,000 by 2000.

Population growth in Kings County has been slow. The 1980 population, 73,738, represented an increase of only 7,021 residents over 1970, almost all of which is attributable to natural increases rather than to in-migration. The Department of Finance estimates that Kings County's population will increase to 82,000 in 1990, and the Department of Water Resources estimates it will increase to more than 92,000 by 2000.

Table 33 presents projected population within the urban member units of Kern County Water Agency. Most of the population lives in the Improvement District No. 4, which serves the Bakersfield metropolitan area.

Water Supply and Demand

Water supplies available for use in the San Joaquin Valley service area consist primarily of runoff from the mountains and foothills bordering the valley, ground water underlying the valley, and imported water diverted from the Sacramento-San Joaquin Delta.

Historically, the valley was flooded during periods of high winter runoff. During the summer, most of the area was a desert. Numerous water control structures and distribution facilities constructed in recent decades have helped equalize water distribution.

Large volumes of water are required to satisfy agricultural needs in the San Joaquin Valley service area. Surface water, most of which is imported, provides most of the water supply to meet these needs. Ground water extractions make up most of the rest. Although precipitation is not a direct source, it determines the amount of surface runoff and recharge of the ground water basin.

Table 34 presents projected supplies for the San Joaquin Valley floor in Kern County. Two SWP supplies are shown: one providing for full entitlement, and one without additional facilities. Table 35 shows the general sources of water available to the member units of the Kern County Water Agency.

Projected sources of supply available to the Tulare Lake Basin Water Storage District are shown in Table 36. Included are two SWP supplies: one providing for full entitlement, and one without additional facilities.

From 1973 to 1980, substantial deliveries of SWP surplus agricultural water have been made to the San Joaquin Valley service area (about 472,610 acre-feet per year, excluding 1977 during the drought). These deliveries have been possible because other service areas (primarily Southern California) have been requesting less than full entitlements. However, these surplus deliveries are expected to decrease substantially in the future as Southern California requests full entitlements to meet projected increased water demands.

Projected applied water[3/] for the San Joaquin Valley floor (Kern County) is presented in Table 37. Projected

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3/ Applied Water - The quantity of water delivered to the intake to a city's water system, the farm headgate, the factory, and, for wildlife, the amount of water supplied to a marsh or other wetland, either directly or by incidental drainage flows.

agricultural use is based on the current average unit use of applied water, which in most cases is the result of farm operations that incorporate one or more practices that could be termed water conservation measures. Because of the extensive reuse of agricultural water in this region, net water use[4/] is also shown in Table 37. This table also presents projected urban water demands for the San Joaquin Valley floor (Kern County). The urban water use was based upon the population shown projections in Table 33. The projected applied agricultural water use for the Tulare Lake Basin Water Storage District (WSD) is about 357,000 acre-feet per year.

In both the San Joaquin Valley portion of Kern County and the Tulare Lake Basin WSD, water use exceeds water supplies, even with full SWP entitlements. Deficiencies are made up by overdrafting ground water supplies.

Impacts of Future SWP Deliveries

Economic Impacts

The economic consequences of the delivery of SWP supplies to the San Joaquin Valley service area are presented in the following section. Included are the changes in SWP contractors' acreages, as well as the direct, indirect, and induced income and employment impacts.

The San Joaquin Valley agricultural impacts were estimated with the use of a linear programming model--the Central Valley Agricultural Model (CVAg). This model was developed to forecast agricultural water demands in the Central Valley. Appendix B discusses this model and the methodology used for estimating the agricultural economic impacts.

Acreage and Ground Water Pumping. In 1981, approximately 740,900 acres were irrigated in the SWP service area. If the SWP delivers full entitlement (Scenario 1), then this total acreage is projectd to increase to about 858,400 acres by 2020, as shown in Table 38. During this time, 1981-2020, the contractors' cropping patterns do not change significantly. The largest crop type is field crops (primarily cotton), composing about 66 percent of the total crop acreages after 2010. In Scenario 2, total acreages after 2010 drop below Scenario 1 levels, mostly because of a decrease in field crops. In Scenario 3, total acreages beyond 2010 increase over Scenario 2 levels, primarily because of an increase in acreage planted in low water-using grain and hay crops. The trend

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4/ Net Water Use - The sum of the evapotranspiration of applied water required in an area, the irrecoverable losses from the water distribution system, and the drainage outflow leaving the area.

toward decreasing field crops, partially offset by increased grain and hay acreages, continues into Scenario 5.

Changes in SWP contractors' total acreages between scenarios are shown in Table 39. The average annual reduction in total contractors' acreages between Scenarios 1 and 5 in the 1980s is about 37,500 acres. By 2020, the total acreage impact between Scenarios 1 and 5 is about 20,700 acres.

Even with the reduced SWP deliveries of Scenarios 5, acreages are still projected to increase above current levels beyond 1990. For example, beyond 2020, Scenario 5 acreages are about 96,800 acres more than currently grown in the service area. And, from 2010 to 2019, Scenario 5 acreages actually exceed Scenario 1 acreages. This apparent contradiction (that contractors' acreages could increase over current levels or future Scenario 1 levels, even with reduced SWP deliveries) can be explained in two ways. First, the contractors will reduce field crop acreages, but this reduction is offset by the substitution of low water-using grain and hay crops. Second, to the extent economically and physically possible, the contractors will substitute ground water supplies for the reduced SWP deliveries.

As discussed above, the acreage reduction from Scenario 1 to Scenario 5 is less than might be expected because, to the extent economically and physically possible, SWP contractors substitute ground water supplies to make up for the reduction in SWP deliveries. Table 40 illustrates the increase in ground water pumping that occurs in the San Joaquin Valley service area as the SWP deliveries are reduced through the five scenarios. In the 1980s, the average annual ground water pumping increase is about 420,000 acre-feet. This activity increases through 2000, then declines to about 444,900 acre-feet per year more beyond 2020.

Such increases in ground water pumping would have additional socioeconomic impacts in the service area. Ground water levels would decline more rapidly, requiring the deepening of wells and extension of pumping equipment. As this occurs, more energy for pumping will be required, thereby increasing pumping costs. Eventually, the increased ground water pumping costs could cause land to be removed from production, which would result in a further loss to the economy. In addition, land subsidence would continue, and community costs would be incurred to repair the damage to surface facilities.

It is questionable whether this additional pumping could be sustained for a long time in a ground water basin that is already in overdraft. To test the impact of reduced ground water availability (because of economic, physical, or legal limitations), Scenario 5 was re-evaluated, using the same Scenario 5 SWP deliveries but with reduced ground water. The reduced ground water availability is shown in Tables 38 through 42, Table 44, and

Table 45 as Scenario 5 (RGW); reduced ground water was not evaluated for the 1980s.

The combination of limited additional ground water pumping and reduced SWP deliveries (Scenario 5 (RGW)) has a significant effect on the San Joaquin Valley. As shown in Table 39, contractors' total acreages decrease 41,800 acres from Scenario 5 to Scenario 5 (RGW); the total acreage reduction from Scenario 1 to Scenario 5 (RGW) is about 62,500 acres for 2020 and beyond.

<u>Income</u>. Average annual agricultural direct income impacts to the SWP contractors are presented in Table 41. During the 1980s, the firm yield average annual income impact between Scenarios 1 and 5 is about $43.7 million (1982 dollars). By 2020, the impact between these two scenarios is about $103.7 million. If the contractors are unable to substitute ground water supplies for the reduced SWP supplies, then the average annual impact beyond 2020 more than triples to $334.6 million.

In addition to the direct income impacts in the contractors' areas, reductions in SWP supplies will also affect the direct income of other areas in the State, especially in other parts of the Central Valley. The changes occur because of shifts in comparative advantage as prices change over time and water availability changes among scenarios. Table 42 displays the valleywide direct income impacts between scenarios.

From 2000 on, valleywide direct income losses exceed those of the contractors. For example, the valleywide direct impact in 2020 is $123.1 million, whereas the contractors' loss is $103.7 million (the difference between Scenarios 1 and 5 shown in Table 41). This implies that areas outside the contractors' areas lose $19.4 million (from shifts in cropping patterns), even though their water supply was unchanged. Beyond 2020, the statewide direct, indirect, and induced income impact is over $1.0 billion.

San Joaquin Valley M&I firm yield income impacts are shown in Table 43. During the 1980s, the average annual direct income impact between Scenarios 1 and 5 is about $30.1 million; statewide, the direct, indirect, and induced income impact is about $124.6 million. Beyond 2020, the average annual direct M&I income impact between these two scenarios is about $93.2 million, and the statewide direct, indirect, and induced impact is about $385.8 million.

<u>Employment</u>. Average annual contractor agricultural employment impacts are presented in Table 44. During the 1980s, the average annual employment impact is about 400 person-years. By 2020, the average annual impact is about 600 person-years. If the contractors are unable to substitute ground water supplies for the reduced SWP supplies, then the average annual employment impact beyond 2020 is about 4,800 person-years.

Direct valleywide agricultural employment impacts (Table 45) between Scenarios 1 and 5 in the 1980s are about 200 person-years, which is less than the contractors' impact of 400 person-years (Table 44). This indicates that changes in cropping patterns elsewhere in the Central Valley have compensated for some of the contractors' loss. However, by 2020, the valleywide average annual impact between these two scenarios is about 800 person-years, about 200 person-years more than the contractors' impact. Statewide, the direct, indirect, and induced employment impact after 2020 is about 2,300 person-years.

San Joaquin Valley M&I employment impacts are shown in Table 46. During the 1980s, the average annual direct impact between Scenarios 1 and 5 is about 2,800 person-years. Statewide, the direct, indirect, and induced employment impact is about 18,900 person-years. By 2020, the direct employment impact is about 8,700 person-years and the statewide direct, indirect and induced employment impact is about 58,800 person-years.

Social Impacts

Changes in San Joaquin Valley service area population and housing units are discussed in the following section.

Population. During the 1980s, the average annual population impact between Scenarios 1 and 5 is about 5,200 persons, and by 2020, the average annual firm yield impact between these two scenarios is about 16,000 persons. Population impacts are presented in Table 47.

Housing Units. Total annual housing unit impacts in the 1980s average about 2,400 units. By 2020, the average annual impact is about 7,100 units. Housing unit impacts are presented in Table 48.

Social Services. The impact of increased water supplies upon social services in the service area will be mixed. Increases in income and employment are indicated, both at the local (service area) and State levels. As a result, the State and local governments could experience some increase in revenues from taxes and other sources. However, additional socioeconomic activity can also place a strain upon local agencies because they must expand services for this population. Many communities have found growth to be a mixed blessing because the costs of providing more services have frequently outstripped revenues.

Environmental Impacts

The delivery of SWP supplies to the San Joaquin Valley service area will affect income and employment in agriculture and water-related industries. Economic opportunities provided by the water will support population and urban development, which in turn affects the environment. Environmental impacts examined in the following discussion are changes in land use, vegetation, wildlife, and water and air quality.

The scope of this report does not allow for the identification of specific lands that might be converted to agricultural or urban uses. It is therefore difficult to predict with any degree of certainty where specific impacts will occur in the San Joaquin Valley service area. Environmental values change from one locale to another, and an action that would benefit one area could destroy important values in another.

Land Use. Agriculture will continue to be the dominant land use in the service area. While conversion of agricultural lands to urban uses would create some environmental impacts, these impacts would be minimized in Kern County by zoning regulations that require urban areas to be contiguous with existing urban areas. The most significant environmental impacts associated with future SWP deliveries would be the conversion of remaining natural lands to agricultural uses.

Projected total contractors' acreages, population, housing units, and acreage requirements for the San Joaquin Valley service area are shown in Table 49. The SWP will affect projected land use in the service area, primarily through its impact upon contractor-irrigated acreages, population, and required acreages for associated housing.

Comparisons of Scenario 1 impacts with the historical activity associated with the SWP indicates total growth resulting from full deliveries. Table 50 makes such a comparison. In the left margin are the socioeconomic impacts that are being measured. In the first column are the average annual total levels of socioeconomic activity affected by SWP deliveries over the period 1979-1983. For example, during this period, a total of about 740,900 contractor-irrigated acres were affected per year by SWP deliveries. Also during this period, a total of 13,700 persons were affected per year. The relative size of this estimate can be determined by comparing it with the total population of the San Joaquin Valley service area in 1980, or about 241,200 persons (Table 49).

Between 1980 and 1989, full deliveries of the SWP (Scenario 1) will impact an estimated additional 17,900 contractor-irrigated acres, and an additional 6,000 persons above the historical averages (Table 50). During the 1990s, Scenario 1 deliveries will affect about 39,000 contractor-irrigated acres and 11,900 persons more than the historical average, and between 2000 and 2009, about 61,500 contractor-irrigated acres and 11,900 more persons. Table 50 also presents the increase in housing units and required acreages associated with the growth in urban populations. During the 1980s, Scenario 1 will affect an additional 2,700 housing units, which would require about 450 more acres. By

2010, this scenario will affect an additional 5,300 housing units, which would require an additional 895 acres.

The relative size of these growth impacts can be determined by comparing them to the increase in total forecasted socioeconomic activity in the San Joaquin Valley service area. For example, during the 1980s, the irrigated acreage and population growth impact of Scenario 1 is about 17,900 acres and 6,000 persons. From 1980 to 1990, total contractor-irrigated acres and total population in the service area is projected to increase by 39,000 acres and 58,900 persons (Table 49). Therefore, the SWP irrigated acreage and population impacts are about 45.9 and 10.2 percent of the total service area increases (Table 50). By 2010, these impacts are about 68.7 and 8.4 percent of the total projected service area increases (Table 51).

Comparisons of the historical average (Column 1, Table 50) with Scenarios 4 and 5 indicate whether the service area will experience growth or lose activity if the SWP remains at or falls below current yield. For the San Joaquin Valley service area, no growth in contractor-irrigated acreages is projected through 1989 under Scenario 4. From 1990, the service area would experience some SWP-associated growth in both contractor-irrigated acreages and population. Under Scenario 5, however, no growth would occur in irrigated acreages or SWP associated population until after 1990.

In conclusion, agricultural and urban expansion in the San Joaquin Valley service area is expected to continue having some significant environmental effects on land use. Expansion of contractor-irrigated acreages will be associated with all the SWP scenarios by 1990. The SWP-induced agricultural expansion (Scenario 1) may be significant since it represents about 68.7 percent of the total projected irrigated acreage growth in the service area between 1980 and 2010 (Table 51). SWP-induced urban expansion will be insignificant since, under Scenario 1, it represents only about 8.4 percent of the total projected population growth for the period 1980-2010.

Vegetation. Some irrigation districts in the San Joaquin Valley service area may lose some riparian habitat as a result of increased SWP deliveries (these include the County of Kings, Tulare Lake Basin, Empire West Side, and KCWA member units: Wheeler Ridge-Maricopa, Semitropic, Buena Vista, and Henry Miller water agencies). However, this loss of vegetation would not be significant because these districts are already intensively farmed and most of their vegetation has been replaced by cultivated plants and exotics.

Plant species most threatened by land conversion in the service area are the rare cottony buckwheat, green fiddleneck, temblor buckwheat, striped adobe lily, and Greene's Orcutt grass and the endangered Lost Hills saltbush and slough thistle. The significance of the potential impacts on these species varies, depending upon the distribution of each. The impact to the cottony buckwheat, the temblor buckwheat, or the green fiddleneck, which presently have stable or increasing populations, may not be as significant as the potential impact to the striped adobe lily, Greene's Orcutt grass, Lost Hills saltbush, or slough thistle because these latter species are declining. This is especially true in the case of Greene's Orcutt grass, which is not only decreasing but is endangered throughout its range.

In the Kern Delta and Rosedale-Rio Bravo Water Districts, the valley mesquite association may be further diminished by irrigated agricultural expansion into this unique habitat type.

Most of the natural areas within the San Joaquin Valley service area would not be adversely impacted by an increase in water supplies to the area. However, two natural areas, the Buena Vista Mesquite Area and the Lost Hills Area, presently being partially farmed, could be expected to be replaced entirely by irrigated agriculture and their subsequent natural values eliminated.

Maintaining current yields or decreasing entitlements in the San Joaquin Valley service area could bring about greater dependence on alternative water sources such as ground water supplies. Greater dependence on ground water would lead to increased pumping, which would result in a continued lowering of the ground water table. Greater dependence on ground water would indirectly degrade riparian habitats in natural areas by reducing the base flow to these areas.

If ground water were not available, some of the more water-intensive crops might be eliminated in favor of crops that require less water or are dry-farmed. As an alternative to changing crop types, land could be taken out of production and allowed to revert to natural conditions. If this were to occur, these lands would eventually provide some forage and cover for wildlife and increase available habitat. Even some native vegetation, long suppressed by intensive agricultural use of the land, might also revegetate the abandoned acreages.

<u>Wildlife</u>. Much of the natural environment in this service area has been altered by agricultural activities. Importation of SWP M&I supplies would have no urban growth impacts on the rare Kern Canyon slender salamander. The habitat for this species lies within the Sequoia National Forest, and the Kern County General Plan shows the area zoned as recreational land (a designation used primarily for public-owned open space land). Increased recreational activity in the Kern River Canyon, however, could affect this reptile.

No impacts to the rare Tehachapi slender salamander are expected as a result of full SWP deliveries. This species occurs in a rural area used mainly for grazing, and no urban or agricultural development is projected in that region.

Most of the urban growth in the service area will occur in the Bakersfield area, about 30 miles to the east. Limited urban growth in western Kern County is projected to occur in the communities of McKittrick, Maricopa, Taft, and Ford City. M&I SWP entitlement to the Western Kern Water District is used primarily for oil field injection. While urban growth and oil field development could displace some foraging habitat, impacts to sensitive species such as the rare San Joaquin antelope squirrel and the rare giant kangaroo rat are expected to be minor. Deliveries of SWP M&I supplies to the San Joaquin Valley service area could also impact the Swainson's hawk.

Increased deliveries of SWP agricultural water supplies could bring new lands under cultivation and subsequently cause a faunal shift from animals that have adapted to the native community to those that can more readily adapt to an irrigated cropland environment. Kangaroo rat, whiptail lizard, and San Joaquin antelope squirrel populations will be reduced, while populations of species with high reproduction rates or greater adaptability to irrigated cropland, such as the California ground squirrel, deer mouse, and pocket gopher, will increase. Some bird species such as Brewer's blackbirds, crows, and sparrows will also increase. Populations of shrikes and raptors, however, can be expected to decline, since these species generally avoid areas of intensive agriculture.

Rodent populations in the service area could increase to a point at which control by rodenticides may be necessary. Some direct wildlife losses can occur from the short-term food chain transfer of some of the less persistent restricted rodenticide materials. Increased use of rodenticides could impact carnivores farther up the food chain.

In the Henry Miller Water District, in Kern County, increased SWP water supplies could have a beneficial effect on wildlife by increasing the size of the Buena Vista Aquatic Recreation Area, a marsh area north of Buena Vista Lake. This increase would arise from irrigation water that is not transpired or evaporated (tailwater) and from seepage.

Impacts to rare and endangered wildlife would be minimal in the Wheeler Ridge-Maricopa, Semitropic, Empire West Side, Tulare Lake Basin, and County of Kings Water Districts because these districts have already been extensively cultivated.

In the remaining member units of the Kern County Water Agency, an increase in SWP water supplies could allow existing habitat to be converted to cropland, thus adversely affecting the rare San Joaquin kit fox, the rare San Joaquin antelope squirrel, the endangered blunt-nosed leopard lizard, and the rare giant kangaroo rat. The endangered bald eagle may also be adversely affected because this species is always forced out of areas of intensive agriculture through the elimination of its foraging and habitat areas.

Impacts to rare or endangered wildlife species would be the most significant in such water districts as Belridge, Berrenda Mesa, Lost Hills, and Cawelo because these districts have the greatest potential for bringing existing areas of natural vegetation under cultivation. Wildlife species most threatened by potential land conversion in these areas include the rare San Joaquin antelope squirrel, the rare San Joaquin kit fox, the rare giant garter snake, the endangered bald eagle, the rare blunt-nosed leopard lizard, and the rare giant kangaroo rat.

In summary, the principal reason for the past decline in rare or endangered species in the service area has been the loss of habitat to agricultural development. Consequently, any increased agricultural development in the service area could be expected to hasten this trend. Recovery plans have been prepared for the rare blunt-nosed leopard lizard and the rare San Joaquin kit fox.[5/] [6/] The primary objective of the plan for the lizard is to halt the species' decline and restore the lizard to a nonendangered status. The plan recommends that management practices be encouraged along the California Aqueduct to enhance the lizard's habitat and that possible habitat restoration measures be determined. The plan calls for establishment of several ecological reserves and identifies land units within the southern San Joaquin Valley that are considered important to the lizard's recovery. A similar plan has also been prepared for the San Joaquin kit fox. The plan would stabilize and then improve populations of kit fox at about 1981 levels and restore this subspecies to a nonendangered status. The plan also proposes a number of actions that emphasize management and restoration of existing public lands and acquisition of additional lands to protect the kit fox.

Water Quality. No significant urban water quality problems are expected to occur in this service area in 1990 or beyond because of M&I water use. However, some problems may arise in the future because of a high water-use rate in this area, and, because of the reduced taxing ability of local governments, financing of municipal waste water treatment plants may become very difficult.

Perched water table conditions threaten to cause drainage problems in the Lost Hills and Buena Vista Water Districts.

5/ Blunt-Nosed Leopard Lizard Recovery Plan (draft), Blunt-Nosed Leopard Lizard Recovery Team, January 1980.

6/ San Joaquin Kit Fox Recovery Plan (draft), Thomas P. O'Farrell, U.S. Fish and Wildlife Service, Endangered Species Program, 1983.

These conditions exist because clay lenses within the upper levels of the soil profile cause salt-laden waters to accumulate and rise steadily as irrigation and leaching continue. The salty water eventually rises high enough to encroach upon the root zone. If this were to happen, the following problems can be expected to occur: (1) leaching would be ineffective because the leaching water and the salt it contains stays near the surface; (2) capillary action that draws the salty water upward would evaporate from the surface, leaving a salt residue; and (3) high ground water levels would deprive roots of oxygen.7/ If no drainage facilities were installed in these areas, the increase in soil salinity may cause land to be taken out of production.

Increased use and disposal of pesticides could also cause ground water problems. As deliveries from the SWP are increased, increased acreages of land could be brought into production, and a sizeable increase in double-cropping could take place in the service area. These two factors would then lead to an increase in the use of pesticide that could be leached into ground water supplies.

Ground water overdrafting has become less of a concern since SWP water has been introduced into the San Joaquin Valley service area. This is particularly true of the Wheeler Ridge-Maricopa Water Storage District, where the Wheeler Front Ground Water Basin has achieved hydrologic balance. The White Wolf Ground Water Basin in the same district is expected to achieve this balance in 1990, should full delivery of contracted-for water (263,200 acre-feet) from the SWP be reached.

In the Semitropic Water Storage District, the ground water has deteriorated due to continued depletion. The water is of poor quality and is unsatisfactory for all but highly salt-tolerant crops. With the delivery of additional SWP water supplies to the area, land that might otherwise have been taken out of production can be kept in production. Additional SWP deliveries would also reduce the amount of ground water pumped, which would halt the eastward migration of saline water in some parts of the district.

One of the major water quality problems associated with increased SWP agricultural supplies is that this water would bring additional salts into the service area. Although the quality of the imported water is good and within the specified limits, salts in the imported water could in time build up to problem levels. These salts would remain in the districts and, unless they are removed, would further degrade the quality of the ground water.

7/ Agricultural Drainage and Salt Management in the San Joaquin Valley (Final Report), San Joaquin Valley Interagency Drainage Program, June 1979.

Initially, the imported water has a concentration of total dissolved solids ranging from 200 to 500 mg/L. When this water has been used one or more times after the first application, its quality progressively worsens. If these concentrated salts are not leached out, agricultural productivity will decline.

In the Berrenda Mesa Water District, the subsurface soils are well drained, and there are no defined shallow aquifers under the district to collect and hold the imported salts that would leach into the ground water. Because of these factors, the salts may eventually reach the brackish water beds in the Tulare Lake Basin and contribute to the existing adverse conditions of this hydraulically closed basin.

Air Quality. According to attainment plans for the San Joaquin Valley Air Basin, oxidant emissions are projected to decrease and should be within attainment levels by 1987. Expansion of industrial and urban activity around the Bakersfield area could increase sulfur dioxide, nitrogen oxide, and carbon monoxide emissions. However, it is projected that, by implementing strict emission measures and controls, this area would reach attainment for all air pollutants (except total suspended particulates) by 1987. Total suspended particulates will continue to be a problem in the service area. Agricultural operations are the primary contributors to particulate emissions. Increasing SWP entitlement deliveries would increase particulate emissions originating in the service area.

Table 29: Maximum Entitlements of Kern County Water Agency's Member Units
(thousands of acre-feet)

Belridge Water Storage District	163.0	
Berrenda Mesa Water District	155.1	
Buena Vista Water Storage District	21.3	
Buttonwillow Irrigation District	83.0	
Cawelo Water District	38.2	
Henry Miller Water District	35.5	
Improvement District No. 4	77.0	(M&I)
Kern Delta Water District	25.5	
Lost Hills Water District	140.4	
Pond Poso Irrigation District	62.0	
Rosedale-Rio Bravo Water Storage District	29.9	
Semitropic Water Storage District	8.0	
Tehachapi-Cummings Water District	4.3	
	15.3	(M&I)
Tejon-Castac Water District	2.0	(M&I)
West Kern Water District	25.0	(M&I)
Wheeler Ridge-Maricopa Water Storage District	263.2	
Total	1,153.4	

Municipal and industrial use is shown as M&I; all other use is agricultural.

Table 30: Rare and Endangered Species
San Joaquin Valley Service Area

Scientific Name	Common Name	Status[1/]
PLANTS		
Hemizonia arida	Red Rock tar plant	SR
Neostaphia colusana	Colusa grass	SE
Orcuttia greenei	Greene's Orcutt grass	SR
Orcuttia inaequalis	San Joaquin Valley Orcutt grass	SE
AMPHIBIAN		
Batrachoseps stebbinsi	Tehachapi slender salamander	SR
REPTILES		
Charina bottae umbratica	Southern rubber boa	SR
Gambelia silus	Blunt-nosed leopard lizard	SE,FE
Thamnophis couchi gigas	Giant garter snake	SR
BIRDS		
Coccyzus americanus occidentalis	California yellow-billed cuckoo	SR
Gymnogyps californianus	California condor	SE,FE
Haliaeetus leucocephalus	Bald eagle	SE,FE
MAMMALS		
Ammospermophilus nelsoni	San Joaquin antelope squirrel	SR
Dipodomys ingens	Giant kangaroo rat	SR
Vulpes macrotis mutica	San Joaquin kit fox	SR,FE

1/ SE = State listed endangered species
FE = Federally listed endangered species
SR = State listed rare species

Table 31: 1980 SWP Irrigated Crop Acreages

Crop	Kern County	Kings County	Stanislaus County	Total
Orchards	51,225	6,288	646	58,159
Vineyards	16,919	0	0	16,919
Truck Crops	20,842	1,905	194	22,941
Field Crops	215,008	52,836	1,896	269,740
Miscellaneous	391	0	0	391
Total	304,385	61,029	2,736	368,150

Source: Department of Water Resources, San Joaquin District, San Joaquin Valley Post-Project Economic Impact, 1980, September 1981.

Table 32: 1980 Irrigated Crop Acreages: Comparison of California, San Joaquin Valley, and San Joaquin Valley Service Area

Region	Orchards	Vineyards	Truck	Field	Nursery	Total
San Joaquin Valley Service Area 1/	58,149	16,919	22,941	269,740	391	368,150
San Joaquin Valley 2/	775,000	535,000	293,000	3,740,000	NTS 3/	5,486,000
California, Total	1,348,000	679,000	822,000	6,995,000	NTS 3/	9,844,000

1/ Acres irrigated with SWP supplies.
2/ Includes San Joaquin and Tulare Lake Hydrologic Study Areas.
3/ Not tabulated separately.

Table 33: Projected Population of Urban Member Units of Kern County Water Agency

Member Unit	1980	1990	2000	2010
Improvement District No. 4 (Bakersfield)	214,400	268,500	306,300	344,200
Tehachapi-Cummings Water District	9,500	12,600	15,400	18,600
West Kern Water District	17,300	19,000	19,300	19,700
Total	241,200	300,100	341,000	382,500

Table 34: Major Water Supplies - Kern County San Joaquin Valley Floor (thousands of acre-feet)

	1980	1990	2000	2010
Natural Ground Water	135	135	135	135
Local Surface Water	515	515	515	515
Central Valley Project (federal)	425	425	425	425
Potential M&I Waste Water Reclamation	-	41	48	55
SWP, Full Entitlement	625	1,132	1,132	1,132
SWP, without Additional Facilities	[625]	[562]	[508]	[508]
Total, Full Entitlement	1,700	2,248	2,255	2,262
Total, without Additional Facilities	[1,700]	[1,678]	[1,631]	[1,638]

Source: Department of Water Resources, State Water Project; Recommended Water Management Plan for Kern County Water Agency (draft).

Brackets indicate reduced SWP deliveries.

Table 35: Sources of Supply for Member Units of Kern County Water Agency

Member Unit	SWP (Agency)	CVP	Local Surface	Ground Water
Belridge WSD	X			
Berrenda Mesa WD	X			
Buena Vista WSD	X	2/	X	X
Cawelo WD	X		1/	X
Henry Miller WD	X		X	minor
Improvement District No. 4	X		X	X
Kern Delta WD	X		X	X
Kern-Tulare WD	4/	X	1/	X
Lost Hills WD	X		3/	minor
Rag Gulch	4/	X	1/	minor
Rosedale-Rio Bravo WSD	X	2/	X	X
Semitropic WSD 5/	X	2/	3/	X
Tehachapi-Cummings CWD	X			X
Tejon-Castac WD	X		X	X
West Kern WD	X		3/	X
Wheeler Ridge-Maricopa WSD	X			X

1/ Kern River water purchased from city of Bakersfield.
2/ Friant-Kern surplus only.
3/ Kern River surplus only.
4/ SWP surplus only.
5/ Includes Buttonwillow ID and Pond Poso ID.

Source: Department of Water Resources, State Water Project; Recommended Water Management Plan for Kern County Water Agency (draft).

Table 36: Major Water Supplies in the Tulare Lake Basin Water Storage District (thousands of acre-feet)

	1980	1990	2000	2010
Natural Ground Water	75.0	75.0	75.0	75.0
Local Surface Supplies	179.0	179.0	179.0	179.0
SWP, Full Entitlement	69.0	118.5	118.5	118.5
SWP, without Additional Facilities	[69.0]	[58.8]	[53.2]	[53.2]
Total, Full Entitlement	323.0	372.5	372.5	372.5
Total, without Additional Facilities	[323.0]	[312.8]	[307.2]	[307.2]

Source: Department of Water Resources, State Water Project; Recommended Water Management Plan for Tulare Lake Basin Water Storage District, (draft).

Brackets indicate reduced SWP deliveries.

Table 37: Estimated Water Use
Kern County
San Joaquin Valley Floor
(thousands of acre-feet)

	1980	1990	2000	2010
Applied Water				
Agriculture	3,280	3,370	3,440	3,560
Urban	130	160	190	210
Total	3,410	3,530	3,630	3,770
Net Water Use				
Agriculture	2,330	2,400	2,440	2,510
Urban	90	130	160	170
Conservation (Urban)	-	(1)	(3)	(5)
Conservation (Agriculture)	-	(39)	(53)	(53)
Total	2,420	2,490	2,544	2,622

Source: Department of Water Resources, State Water Project; Recommended Water Management Plan for Kern County Water Agency (Draft).

Table 38: Projected SWP Contractors' Acreages
(thousands of acres)

Crop Type	1980-1989 Acres	%	1990-1999 Acres	%	2000-2009 Acres	%	2010-2019 Acres	%	2020 + Acres	%
Scenario 1										
Subtropical	9.1	1.2	10.1	1.3	10.4	1.3	11.6	1.4	12.0	1.4
Deciduous	51.6	6.8	50.7	6.5	51.3	5.4	53.2	6.4	54.9	6.4
Grain and Hay	50.1	6.6	83.4	10.7	84.3	10.5	78.9	9.5	81.5	9.5
Field	502.3	66.2	486.7	62.4	497.5	62.0	548.9	66.1	567.5	66.1
Truck	42.5	5.6	43.7	5.6	51.4	6.4	55.6	6.7	57.5	6.7
Pasture	74.4	9.8	75.7	9.7	72.2	9.0	51.5	6.2	53.2	6.2
Vineyards	28.8	3.8	29.6	3.8	35.3	5.4	30.7	3.7	31.8	3.7
Total	758.8	100.0	779.9	100.0	802.4	100.0	830.4	100.0	858.4	100.0
Scenario 2										
Subtropical	9.1	1.2	10.1	1.3	10.4	1.3	11.5	1.4	10.7	1.3
Deciduous	51.6	6.8	50.7	6.5	51.3	5.4	52.4	6.4	52.9	6.4
Grain and Hay	50.1	6.6	83.4	10.7	84.3	10.5	79.4	9.7	80.2	9.7
Field	502.3	66.2	486.7	62.4	497.5	62.0	537.4	65.7	543.9	65.8
Truck	42.5	5.6	43.7	5.6	51.4	6.4	54.8	6.7	54.5	6.6
Pasture	74.4	9.8	75.7	9.7	72.2	9.0	51.5	6.3	53.7	6.5
Vineyards	28.8	3.8	29.6	3.8	35.3	5.4	31.1	3.8	30.6	3.7
Total	758.8	100.0	779.9	100.0	802.4	100.0	818.1	100.0	826.5	100.0

Table 38: Projected SWP Contractors' Acreages (Continued)
(thousands of acres)

Crop Type	1980-1989 Acres	%	1990-1999 Acres	%	2000-2009 Acres	%	2010-2019 Acres	%	2020 + Acres	%
Scenario 3										
Subtropical	9.1	1.2	10.1	1.3	9.3	1.2	10.9	1.3	10.9	1.3
Deciduous	51.6	6.8	51.3	6.6	51.3	5.5	53.5	6.4	53.8	6.4
Grain and Hay	50.1	6.6	88.6	11.4	87.3	11.2	89.5	10.7	90.0	10.7
Field	502.3	66.2	483.2	62.2	478.4	61.3	546.9	65.4	549.9	65.4
Truck	42.5	5.6	38.9	5.0	47.5	6.1	51.8	6.2	52.1	6.2
Pasture	74.4	9.8	74.6	9.6	70.9	9.1	51.8	6.2	52.1	6.2
Vineyards	28.8	3.8	30.3	3.9	34.4	5.5	31.8	3.8	31.9	3.8
Total	758.8	100.0	777.0	100.0	779.1	100.0	836.2	100.0	840.7	100.0
Scenario 4										
Subtropical	8.7	1.2	10.2	1.3	10.3	1.3	11.6	1.4	11.7	1.4
Deciduous	50.6	7.0	51.6	6.6	51.3	5.5	53.2	6.4	53.7	6.4
Grain and Hay	45.6	6.3	100.9	12.9	99.4	12.6	98.9	11.9	99.9	11.9
Field	477.3	66.0	475.1	60.7	476.1	60.4	534.2	64.3	539.6	64.3
Truck	39.8	5.5	38.3	4.9	45.0	5.7	49.9	6.0	50.3	6.0
Pasture	73.0	10.1	75.9	9.7	71.8	9.1	51.5	6.2	52.0	6.2
Vineyards	28.2	3.9	30.5	3.9	34.7	5.4	31.6	3.8	31.9	3.8
Total	723.2	100.0	782.5	100.0	788.6	100.0	830.9	100.0	839.1	100.0

Table 38: Projected SWP Contractors' Acreages (Continued)
(thousands of acres)

Crop Type	1980-1989 Acres	%	1990-1999 Acres	%	2000-2009 Acres	%	2010-2019 Acres	%	2020 + Acres	%
					Scenario 5					
Subtropical	8.7	1.2	10.1	1.3	10.2	1.3	11.7	1.4	11.7	1.4
Deciduous	50.5	7.0	51.9	6.7	51.3	5.5	53.3	6.4	53.6	6.4
Grain and Hay	45.4	6.3	100.6	13.0	103.1	13.1	107.5	12.9	108.9	13.0
Field	476.0	66.0	467.4	60.4	470.7	59.8	527.3	63.3	527.8	63.0
Truck	39.7	5.5	37.9	4.9	44.9	5.7	50.0	6.0	50.3	6.0
Pasture	72.9	10.1	75.8	9.8	71.6	9.1	51.7	6.2	51.9	6.2
Vineyards	28.1	3.9	30.2	3.9	35.3	5.5	31.7	3.8	33.5	4.0
Total	721.3	100.0	773.9	100.0	787.1	100.0	833.2	100.0	837.7	100.0
					Scenario 5 (RGW)1/					
Subtropical	--	--	10.0	1.3	10.7	1.4	9.5	1.2	9.6	1.2
Deciduous	--	--	50.8	6.6	50.0	5.5	49.9	6.3	50.1	6.3
Grain and Hay	--	--	119.4	15.5	140.4	18.4	166.2	21.0	181.5	22.8
Field	--	--	440.9	57.2	404.3	53.0	427.3	54.0	416.2	52.3
Truck	--	--	44.7	5.8	52.6	6.9	60.9	7.7	61.3	7.7
Pasture	--	--	74.7	9.7	70.9	9.3	46.7	5.9	46.2	5.8
Vineyards	--	--	30.0	3.9	34.0	5.5	30.9	3.9	31.0	3.9
Total	--	--	770.5	100.0	762.9	100.0	791.4	100.0	795.9	100.0

1/ Restricted ground water (availability).

Table 39: Average Annual Contractors' Acreage Impact Supported by SWP Firm Deliveries
San Joaquin Valley Service Area
(thousands of acres)

Impacts Between Scenarios	1980-1989	1990-1999	2000-2009	2010-2019	2020+
Scenarios 1 and 2	0	0	0	12.3	31.9
Scenarios 2 and 3	0	2.9	23.3	[18.1]	[14.2]
Scenarios 3 and 4	35.6	[5.5]	[9.5]	5.3	1.6
Scenarios 4 and 5	1.9	8.6	1.5	[2.3]	1.4
Scenarios 4 and 5 (RGW)	- 1/	12.1	25.7	39.5	43.2
Total Impact					
Scenarios 1 and 5	37.5	6.0	15.3	[2.8]	20.7
Scenarios 1 and 5 (RGW)	- 1/	9.5	39.5	39.0	62.5

Brackets indicate acreage increases, caused by an increase in acreage planted in low water-using grain and hay crops and increased ground water pumping.

1/ Restricted ground water (RGW) scenario not estimated for 1980-1989.

Table 40: Increased Ground Water Pumping
San Joaquin Valley Service Area
(thousands of acre-feet)

Impacts Between Scenarios	1980-1989	1990-1999	2000-2009	2010-2019	2020+
Scenarios 1 and 2	0	0	0	95.8	94.2
Scenarios 2 and 3	0	323.5	330.5	180.1	168.4
Scenarios 3 and 4	420.0	148.2	(29.1)	151.8	164.2
Scenarios 4 and 5	0	9.1	186.0	12.7	18.1
Total Impact					
Scenarios 1-5	420.0	480.8	487.4	440.4	444.9
Scenarios 1-5 (RGW) 1/	-	409.6	313.0	145.3	112.7

Impacts represent what would occur during an average year per decade; they are not decade totals.

Parentheses indicate a decrease in ground water pumping between scenarios.

1/ Restricted ground water.

Table 41: Average Annual Contractors' Agricultural Direct Income Impact
Supported by SWP Firm Deliveries
San Joaquin Valley Service Area
(millions of 1982 dollars)

Impacts Between Scenarios	1980-1989	1990-1999	2000-2009	2010-2019	2020+
Scenarios 1 and 2	$ 0	$ 0	$ 0	$ 13.4	$ 16.1
Scenarios 2 and 3	0	24.6	26.3	18.0	21.4
Scenarios 3 and 4	43.7	19.9	20.3	26.7	31.5
Scenarios 4 and 5	0	6.0	11.9	24.4	34.7
Scenarios 4 and 5 (RGW)	--	43.2	97.7	201.1	265.5
Total Impact					
Scenarios 1 and 5	43.7	50.5	58.5	82.5	103.7
Scenarios 1 and 5 (RGW)	--	87.7	144.3	259.2	334.6

Impacts are what would occur during an average year per decade; they are not decade totals.

Table 42: Average Annual Valleywide Agricultural Direct, Indirect, and Induced Income Impacts Supported by SWP Firm Deliveries
(millions of 1982 $)

Impacts Between Scenarios	1980-1989		1990-1999		2000-2009		2010-2019		2020 +	
	Direct	Direct, Indirect & Induced	Direct	Direct, Indirect & Induced	Direct	Direct, Indirect & Induced	Direct	Direct, Indirect & Induced	Direct	Direct, Indirect & Induced
Scenarios 1 and 2	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 18.6	$ 51.5	$ 21.5	$ 59.9
Scenarios 2 and 3	0	0	14.6	40.7	28.2	78.4	22.8	60.2	25.8	71.8
Scenarios 3 and 4	33.8	93.9	20.5	56.8	24.6	68.4	30.3	87.7	37.4	103.9
Scenarios 4 and 5	0	0	6.1	16.9	12.7	35.5	28.6	79.4	38.4	106.9
Scenarios 4 and 5 (RGW)	--	--	34.2	95.0	97.0	269.7	215.7	600.0	281.7	783.0
Total Impact										
Scenarios 1 and 5	33.8	93.9	41.2	114.5	65.5	182.3	100.3	278.9	123.1	342.5
Scenarios 1 and 5 (RGW)	--	--	69.3	192.6	149.8	416.5	287.4	799.2	366.4	1,018.6

Impacts are what would occur during an average year per decade; they are not decade totals.

Table 43: Average Annual M&I Direct, Indirect, and Induced Income Impacts Supported by SWP Firm Deliveries
San Joaquin Valley Service Area
(millions of 1982 $)

Impacts Between Scenarios	1980-1989		1990-1999		2000-2009		2010-2019		2020 +	
	Direct	Direct, Indirect & Induced	Direct	Direct, Indirect & Induced	Direct	Direct, Indirect & Induced	Direct	Direct, Indirect & Induced	Direct	Direct, Indirect & Induced
Scenarios 1 and 2	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 21.3	$ 88.2	$ 22.0	$ 91.1
Scenarios 2 and 3	0	0	42.4	175.5	42.3	175.1	21.9	90.6	21.4	88.6
Scenarios 3 and 4	30.1	124.6	25.1	103.9	25.1	103.9	25.2	104.3	25.2	104.3
Scenarios 4 and 5	0	0	6.4	26.5	10.2	42.2	21.1	87.3	24.6	101.8
Total Impact	30.1	124.6	73.9	305.9	77.6	321.2	89.5	370.4	93.2	385.8

Impacts are what would occur during an average year per decade; they are not decade totals.

Table 44: Average Annual Contractors' Agricultural Direct Employment Impact Supported by SWP Firm Deliveries
San Joaquin Valley Service Area
(thousands of person-years)

Impacts Between Scenarios	1980-1999			1990-1999			2000-2009			2010-2019			2020 +		
	Total	Perma-nent	Sea-sonal	Total	Perma-nent	Sea-sonal	Total	Perma-nent	Sea-sonal	Total	Perma-nent	Sea-sonal	Total	Perma-nent	Sea-sonal
Scenarios 1 and 2	0	0	0	0	0	0	0	0	0	0.1	0	0.1	0.1	0	0.1
Scenarios 2 and 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scenarios 3 and 4	0.4	0.1	0.3	0.1	0	0.1	0	0	0	0.2	0.1	0.1	0.2	0.1	0.1
Scenarios 4 and 5	0	0	0	0	0	0	0.1	0	0.1	0.2	0.1	0.1	0.3	0.1	0.2
Scenarios 4 and 5 (RGW)1/	--	--	--	1.0	0.4	0.6	2.2	1.0	1.2	3.1	1.4	1.7	4.5	2.0	2.5
Total Impact															
Scenarios 1 and 5	0.4	0.1	0.3	0.1	0	0.1	0.1	0	0.1	0.5	0.2	0.3	0.6	0.2	0.4
Scenarios 1 and 5 (RGW)1/	--	--	--	1.1	0.4	0.7	2.2	1.0	1.2	3.4	1.5	1.9	4.8	2.1	2.7

Impacts are what would occur during an average year per decade; they are not decade totals.

1/ Restricted ground water.

Table 45: Average Annual Valleywide Direct, Indirect and Induced Employment Impacts Supported by SWP Firm Deliveries (thousands of person-years)

Impacts Between Scenarios	1980-1989		1990-1999		2000-2009		2010-2019		2020 +	
	Direct	Direct, Indirect & Induced	Direct	Direct, Indirect & Induced	Direct	Direct, Indirect & Induced	Direct	Direct, Indirect & Induced	Direct	Direct, Indirect & Induced
Scenarios 1 and 2	0	0	0	0	0	0	0.4	1.1	0.4	1.2
Scenarios 2 and 3	0	0	0	0	0	0	0	0	0	0
Scenarios 3 and 4	0.2	0.6	0	0	0	0	0.1	0.3	0.1	0.3
Scenarios 4 and 5	0	0	0.1	0.3	0.1	0.2	0.2	0.6	0.3	0.8
Scenarios 4 and 5 (RGW)1/	--	--	1.0	2.8	2.1	6.0	2.9	8.4	3.6	10.2
Total Impact										
Scenarios 1 and 5	0.2	0.6	0.1	0.3	0.1	0.2	0.7	2.0	0.8	2.3
Scenarios 1 and 5 (RGW)1/	--	--	1.0	2.8	2.1	6.0	3.4	9.8	4.1	11.7

Impacts are what would occur during an average year per decade; they are not decade totals.

1/ Restricted ground water.

Table 46: Average Annual M&I Direct, Indirect, and Induced Employment Impacts Supported by SWP Firm Deliveries
San Joaquin Valley Service Area
(thousands of person-years)

Impacts Between Scenarios	1980-1989		1990-1999		2000-2009		2010-2019		2020 +	
	Direct	Direct, Indirect & Induced	Direct	Direct, Indirect & Induced	Direct	Direct, Indirect & Induced	Direct	Direct, Indirect & Induced	Direct	Direct, Indirect & Induced
Scenarios 1 and 2	0	0	0	0	0	0	2.0	13.5	2.0	13.5
Scenarios 2 and 3	0	0	3.9	26.5	3.9	26.5	2.0	13.6	2.0	13.6
Scenarios 3 and 4	2.8	18.9	2.4	16.2	2.4	16.2	2.4	16.2	2.4	16.2
Scenarios 4 and 5	0	0	0.5	3.3	1.0	6.7	2.0	13.5	2.3	15.5
Total Impact	2.8	18.9	6.8	46.0	7.3	49.4	8.4	56.8	8.7	58.8

Impacts are what would occur during an average year per decade; they are not decade totals.

C-095203

Table 47: Average Annual Population Impact Supported by SWP Firm Deliveries
San Joaquin Valley Service Area
(thousands of persons)

Impacts Between Scenarios	1980-1989	1990-1999	2000-2009	2010-2019	2020 +
Scenarios 1 and 2	0	0	0	3.5	3.6
Scenarios 2 and 3	0	7.0	6.9	3.6	3.5
Scenarios 3 and 4	5.2	4.1	4.1	4.5	4.5
Scenarios 4 and 5	0	1.0	1.8	3.8	4.4
Total Impact	5.2	12.1	12.8	15.4	16.0

Impacts are what would occur during an average year per decade; they are not decade totals.

Table 48: Average Annual Housing Unit Impact Supported by SWP Firm Deliveries
San Joaquin Valley Service Area
(thousands of units)

Impacts Between Scenarios	1980-1989			1990-1999			2000-2009		
	Total	Single Family	Multiple Family	Total	Single Family	Multiple Family	Total	Single Family	Multiple Family
Scenarios 1 and 2	0	0	0	0	0	0	0	0	0
Scenarios 2 and 3	0	0	0	3.1	2.5	0.6	3.1	2.5	0.6
Scenarios 3 and 4	2.4	1.8	0.6	1.9	1.4	0.5	1.9	1.4	0.5
Scenarios 4 and 5	0	0	0	0.4	0.4	0	0.8	0.6	0.2
Total Impact	2.4	1.8	0.6	5.4	4.3	1.1	5.8	4.5	1.3

Impacts Between Scenarios	2010-2019			2020 +		
	Total	Single Family	Multiple Family	Total	Single Family	Multiple Family
Scenarios 1 and 2	1.6	1.2	0.4	1.6	1.2	0.4
Scenarios 2 and 3	1.6	1.3	0.3	1.6	1.3	0.3
Scenarios 3 and 4	2.0	1.5	0.5	2.0	1.5	0.5
Scenarios 4 and 5	1.7	1.4	0.3	1.9	1.6	0.3
Total Impact	6.9	5.4	1.5	7.1	5.6	1.5

Impacts are what would occur during an average year per decade; they are not decade totals.

Table 49: Total Projected Contractor-Irrigated Acreage, Population, Housing Unit, and Acreage Requirements
San Joaquin Valley Service Area

	1980	1990	2000	2010
Contractor-Irrigated Acreage (thousands of acres)	740.9 1/	779.9	802.4	830.4
Population (thousands of persons)	241.2	300.1	341.0	382.5
Housing Units (thousands of units)				
Single Family	77.9	97.9	109.7	120.6
Multiple Family	16.6	23.5	28.6	34.4
Total Housing	94.5	120.9	138.3	155.0
Acreage Requirements (thousands of acres)				
Single Family 2/	15.6	19.5	21.9	24.1
Multiple Family 3/	0.8	1.2	1.4	1.7
Total Acres	16.4	20.7	23.3	25.8

1/ 1981 actual SWP contractor-irrigated acreage.

2/ Assumes 1 acre could accommodate 5 single family units.

3/ Assumes 1 acre could accommodate 20 multiple family units.

Table 50: SWP Impacts Above Historical Activity, San Joaquin Valley Service Area[1/]

	1979-1983[2/] SWP Annual Average	1980-1989 Scenario 1	1980-1989 Scenario 4	1980-1989 Scenario 5	1990-1999 Scenario 1	1990-1999 Scenario 4	1990-1999 Scenario 5	2000-2009 Scenario 1	2000-2009 Scenario 4	2000-2009 Scenario 5
Contractor-Irrigation Acreage (thousands of acres)	740.9	17.9	(17.7)	(19.6)	39.0	41.6	33.0	61.5	47.7	46.2
Population (thousands of persons)	13.7	6.0	0.8	0.8	11.9	0.8	(0.2)	11.9	0.8	(0.9)
Housing Units (thousands of units)										
Single Family	4.8	2.1	0.3	0.3	4.2	0.1	(0.1)	4.2	0.1	(0.3)
Multiple Family	1.4	0.6	0	0	1.1	0	0	1.1	0	(0.2)
TOTAL	6.2	2.7	0.3	0.3	5.3	0.1	(0.1)	5.3	0.1	(0.5)
Acreage Requirements (thousands of acres)										
Single Family[3/]	960	420	60	60	840	20	(20)	840	20	(60)
Multiple Family[4/]	70	30	0	0	55	0	0	55	0	(10)
TOTAL	1,030	450	60	60	895	20	(20)	895	20	(70)

1/ These impacts are the incremental changes in historical SWP activity caused by SWP scenario deliveries for each decade. Positive numbers represent an incremental increase in SWP historical activity (growth), while negative numbers (in parentheses) represent incremental decreases in SWP historical activity.

2/ These estimates are the total levels of socioeconomic activity affected by SWP average annual deliveries over the period 1979-1983.

3/ Assumes 1 acre could accommodate 5 single family units.

4/ Assumes 1 acre could accommodate 20 multiple family units.

C—095206

Table 51: SWP Impacts As Percentage of Total Projected Service Area Increase, San Joaquin Valley Service Area[1/]

	1980-1989			1990-1999			2000-2009		
	Scenario 1	Scenario 4	Scenario 5	Scenario 1	Scenario 4	Scenario 5	Scenario 1	Scenario 4	Scenario 5
Contractor-Irrigated Acreage	45.9%	(45.4%)	(50.3%)	63.4%	67.6%	53.7%	68.7%	53.3%	51.6%
Population	10.2%	1.4%	1.4%	11.9%	0.8%	(0.2%)	8.4%	0.6%	(0.6%)
Housing Units									
Single Family	10.8%	1.5%	1.5%	13.2%	0.3%	(0.3%)	9.8%	0.2%	(0.7%)
Multiple Family	8.7	0	0	9.2	0	0	6.2	0	(1.1)
OVERALL HOUSING	10.2	1.1	1.1	12.1	0.2	(0.2)	8.8	0.2	(0.8)
Acreage Requirements									
Single Family	10.8%	1.5%	1.5%	13.3%	0.3%	(0.3%)	9.9%	0.2%	(0.7%)
Multiple Family	7.5	0	0	9.2	0	0	6.1	0	(1.1)
OVERALL ACREAGE	10.5	1.4	1.4	13.0	0.3	(0.3)	9.5	0.2	(0.5)

1/ This compares the incremental percentage change in socioeconomic activity caused by SWP deliveries with the total incremental change projected in Table 24. Positive numbers represent an incremental percentage increase in SWP historical activity (growth), while negative numbers (in parentheses) represent incremental percentage decreases in SWP historical activity.

C-095207

CHAPTER IV. CENTRAL COASTAL SERVICE AREA

Description and Location

The Central Coastal service area consists of the San Luis Obispo County Flood Control and Water Conservation District (FCWCD) and the Santa Barbara County Flood Control and Water Conservation District (FCWCD).

The San Luis Obispo County FCWCD includes all of San Luis Obispo County, encompassing a total area of about 2.1 million acres. The Santa Barbara County FCWCD includes all of Santa Barbara County, encompassing a total area of about 1.8 million acres.

Initially, San Luis Obispo County FCWCD applied for a maximum entitlement of 25,000 acre-feet, and Santa Barbara County FCWCD requested 50,000 acre-feet. While San Luis Obispo's requested entitlement has remained the same, Santa Barbara's request was first boosted to 57,700 acre-feet and, in 1981, lowered by a vote of the District to 45,486 acre-feet.

The water supply contracts between each of these two counties and the State stipulated that SWP water deliveries would commence in 1980; however, these contracts also provided for the deferral or elimination of the Coastal Branch of the California Aqueduct (which is required for deliveries to this service area), if the counties so elected. At the request of the counties, design and construction of the Coastal Branch has been postponed several times. One of the reasons for these delays was the rejection by the voters of Santa Barbara County in March 1979 of a $102 million bond issue for the construction of local distribution facilities for the SWP water. Currently, there are no indications that this decision to defer the Coastal Branch construction will be reversed in the near future. However, for the purposes of this analysis, it will be assumed that the Coastal Branch is constructed during the late 1980s, with deliveries commencing in 1990. SWP entitlement for this service area will be used primarily for M&I purposes.

Figure 8 shows the location of the Central Coastal SWP service area. Figure 9 depicts the service area in detail.

Environmental and Socioeconomic Profile

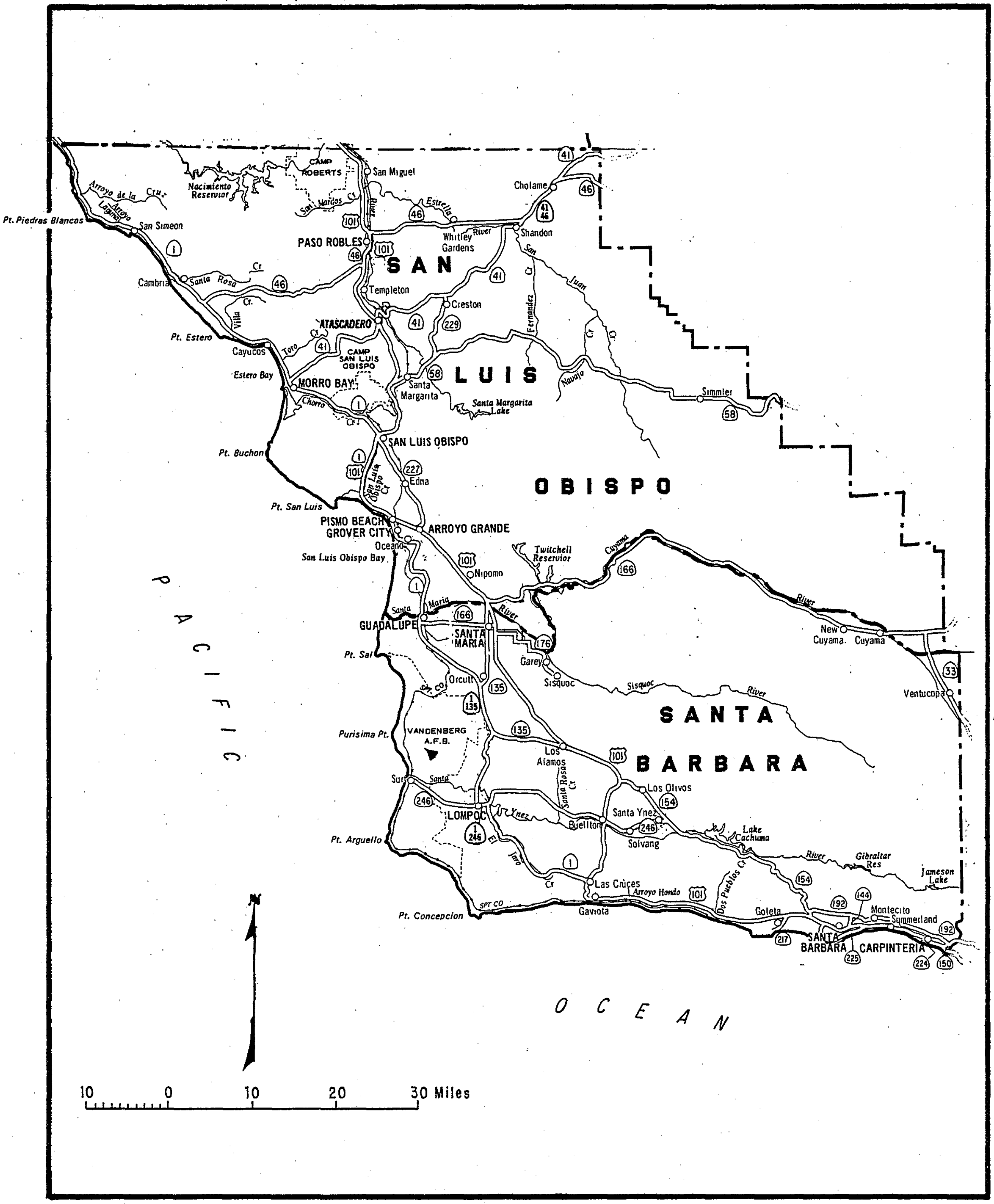
Physical and Biological Environment

Following is a description of the physical and biological environment in the Central Coastal service area. Factors described in this section include climate, vegetation, wildlife, rare and endangered species, and air quality.

Figure 8.
CENTRAL COASTAL SWP SERVICE AREA
STATE WATER PROJECT CONTRACTORS

C-095209

Figure 9. CENTRAL COASTAL SERVICE AREA



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Climate. Temperatures in the Central Coastal service area are influenced by terrain and proximity to the ocean. Coastal temperatures are mild with little fluctuation. Temperatures become more variable inland. Maximum temperatures in July are in the upper 60s (°F) and low 70s (°F) along the coast and in the 90s (°F) in the interior valleys and plains. Generally, the service area's climate is conducive to growing crops year-round.

Average annual rainfall varies from 6 inches in the Cuyama Valley to over 30 inches on the exposed slopes of the high mountains in the southeastern portion of the service area. The coastal area averages about 18 inches of rain per year. Fog is common along the coast and in the coastal valleys in summer and in the interior valleys during winter. Prevailing winds are from the west or southwest and are generally light to moderate.

Vegetation. Much of the natural vegetation in the service area remains relatively undisturbed. Conversion of these areas to agricultural and urban uses has been limited mostly to valleys, alluvial fans and plains, and terraces.

The major vegetation of the area includes the following communities:

Coastal strand occurs on sandy beaches and on moving and stationary dunes.

Salt-water marsh occurs in low tidelands and estuaries (best developed on the shores of Morro Bay, the mouth of San Luis Creek at Avila, among the dunes south of Pismo Beach, Carpinteria, Santa Barbara, Goleta, Santa Ynez River, and the Santa Maria River).

Fresh-water marsh occurs above salt-water marshes and around streams and ponds.1/

Coastal sage scrub consists of low-growing shrubs and occurs along the coast and coastal inland valleys.

Coastal prairie grassland occurs mainly in western San Luis Obispo County and in Cuyama Valley.

Foothill woodland and oak woodland are the most widespread communities in the service area; they serve as transitions between grassland and forest communities, with vegetation representative of both (oak woodlands usually occur on deep, well-drained alluvial terraces or broad, rounded ridge tops, as in the Santa Ynez or Salinas River Valleys).

1/ Because they are close to human habitation, marshes have often been drained and filled for development and are among the most threatened of California plant communities.

Chaparral covers most of eastern Santa Barbara County and the Caliente Range in San Luis Obispo County; occurs on hot, dry slopes, ridges, and mesas, often on poor soils.

Closed-cone pine and mountain coniferous forests occur in small isolated areas such as Cambria, Cypress Mountain, and near Lompoc and Orcutt, and on top of the higher peaks.

Evergreen forest occurs primarily in the Santa Lucia Range.

Pinyon-juniper woodland occurs in the upper Cuyama Valley and adjacent hills on Caliente Mountain.

Riparian woodland occurs mainly along the banks of local streams and lakes.

Desert scrub occurs in the Temblon Range and the south slope of Caliente Mountain.

Alkali sink community occurs in the Carrizo Plain.

Wildlife. Animal populations in the service area are extremely diversified due to the wide variety of plant communities. Some of the more common animal species, which occur in most communities throughout the service area, include the mourning dove, the red-tailed hawk, the white-crowned sparrow, the side-blotched lizard, and the western rattlesnake.

The grassland community provides habitats mainly for grazers and seed eaters. This community supports a variety of wildlife, including several rodent species, raptors, songbirds, game birds, and a number of amphibian and reptile species.

The coastal sage scrub, northern coastal scrub, and chaparral communities share similar fauna. Representative mammals include mule deer, coyotes, bobcats, gray foxes, and skunks. There are also many rodent, bird, and reptile species.

Foothill woodland, oak savannah, and evergreen forest are important habitats because they provide roosting and nesting sites for many birds, particularly raptors. Warblers and fly-catchers are common summer birds. Mammals are similar to those in the foregoing communities.

The coniferous forest provides habitat for many bird species closely dependent on trees. Dominant animals include deer, coyotes, mountain lions, and owls. Chipmunks are largely restricted to this community.

The pinyon-juniper woodland is a transitional community that has animals from both desert and scrub communities.

Representative species include the pinyon mouse and desert night lizard.

Reptiles are the main residents in the desert scrub and alkali sink communities. Representative species include several types of lizard and western rattlesnake. Mammals include San Joaquin kit foxes, striped skunks, pocket mice, and kangaroo rats. Birds such as the roadrunner and mourning dove are fairly common.

The immediate coastal area, which includes coastal strand, tidal mudflats, estuaries, and marshes, has the greatest number and diversity of fauna in the service area. Nearly all coastal vertebrate animals are migratory shore birds, such as plovers, turnstones, sandpipers, and gulls. Mammals include the California ground squirrel, raccoon, and several rodent species. The main reptiles are side-blotched and legless lizards.

The smaller lakes, marshes, and reservoirs in the area are used by a variety of waterfowl, herons, and passerine birds.

Riparian habitat provides a combination of food, water, cover, shade, and nesting sites for wildlife. This habitat is also important to amphibians. Common mammals found in riparian areas include gray foxes, opossoms, raccoons, and California meadow mice.

None of the major rivers in San Luis Obispo County support anadromous fish runs. However, many of the coastal streams (such as San Luis Obispo, Chorro, Santa Rosa, San Simeon, Arroyo de la Cruz, and Pico Creeks) have limited steelhead trout runs and native rainbow trout in their headwaters. Catchable trout are planted in the lower Nacimiento River. Native nongame fish found in perennial streams in the service area include the speckled face, unarmored threespine stickleback, and arroyo chub.

In Santa Barbara County, fresh-water fisheries occur mainly in the coastal streams in the northern part of the county, and in the Sisquoc, Cuyama, and Santa Ynez Rivers. Rainbow trout are stocked in Salsipuedes Creek and in the Santa Ynez River near Solvang. The Sisquoc River also has rainbow trout in its upper reaches. Many of the reservoirs are stocked with warmwater fish such as largemouth and smallmouth bass, bluegill, crappie, and channel catfish. Some have rainbow trout.

Rare and Endangered Species. Because of the overlap between the northern and southern floristic elements, many rare and endangered species inhabit the Central Coastal service area. Table 52 contains a list of rare and endangered species that may occur in this area. (All tables referred to in this chapter appear at the end of this chapter.)

The unarmored threespine stickleback is known to occur in only three localities. One of these localities occurs in the service area in the San Antonio Creek on Vandenberg Air Force Base. The population is threatened by pesticide runoff and increased ground water pumping.

The blunt-nosed leopard lizard occurs in the San Joaquin Valley and surrounding foothills. In the service area, it occurs in the Carrizo Plains and Cuyama Valley. It inhabits sparsely vegetated grassland, desert scrub, and alkali sink areas. Populations have been drastically reduced, mainly by conversion of land to agriculture.

The American peregrine falcon may nest on cliffs in isolated areas near the coast and inland. In 1980, there were 42 breeding pairs throughout California. During migration and in winter, peregrines may occur anywhere; coastal and inland marsh and riparian areas are especially important to these birds during this time.

The California condor occurs in the Coast Range from Santa Clara County south to Los Angeles County and in the southern Sierra Nevadas. They nest in shallow caves or ledges in cliffs and forage over large areas, flying at least 35 miles between roosting and feeding sites. Their habitat includes foothill woodland, grassland, and chaparral in rugged, isolated areas. In the service area, condors nest in the Hi Mountain-Beartrap Condor Area in central San Luis Obispo County and the Sisquoc-San Rafael and Matilija Condor Areas in Santa Barbara County.

The bald eagle historically nested along the coast in the service area, but its nesting range has been reduced to Northern California by pesticide toxicity, human disturbance, and a reduction in numbers of nesting sites. Bald eagles may winter anywhere in California near reservoirs, lakes, and rivers; they are, however, very rare in the service area. Several are known to winter at Lake Cachuma.

The California black rail is a permanent resident of salt marshes and brackish and fresh-water marshes from Marin County southward. In the service area, it is now known to occur only in the Morro Bay marsh. Destruction of coastal and inland marshes by filling and draining has reduced much of its habitat.

The Belding's savannah sparrow is a year-round resident of coastal salt marshes dominated by pickleweed in Southern California. About 1,610 breeding pairs at 28 sites were found in 1977. In the service area, it is known to occur at Goleta Slough and Carpinteria Sloughs. Habitat destruction is the major reason for its decline.

The California brown pelican occurs along the coastline. Marshy areas along the coast provide important foraging areas for this species.

The light-footed clapper rail inhabits cordgrass-pickleweed associations in coastal salt marshes from Santa Barbara southward. It occurs in Goleta Slough and Carpinteria Marsh in the service area. Destruction of habitat by filling and dredging is the major cause for decline of this subspecies.

The California least tern breeds on flat, isolated shady areas or mudflats on the coast from San Francisco Bay southward. In the service area, it occurs at Oso Flaco Lake, Santa Maria River, Purisima Point, and the Santa Ynez River. The least tern is very sensitive to disturbance. Destruction of feeding and nesting areas and human disturbance have reduced the size of the populations.

The least Bell's vireo inhabits a few riparian areas in Southern California. In the service area, it occurs at Mono Creek, Agua Caliente Creek, and Santa Ynez River. This was formerly a very common bird, but nest parasitism by the brown-headed cowbird, predation, and destruction of riparian habitat have reduced the population to fewer than 200 breeding pairs.

The San Joaquin antelope squirrel occurs in the Carrizo Plain and Cuyama Valley. It inhabits dry, sparsely vegetated soil with some shrub cover. About 80 percent of its original habitat has been converted to agriculture. Rodenticides may also be responsible for reducing populations.

The Morro Bay kangaroo rat is restricted to discontinuous areas on the south side of Morro Bay. It inhabits early stages of succession of chaparral where plants are low and sparse. The total range of this subspecies decreased from 4.8 square miles in 1957 to less than 0.5 square mile in 1978. The major reasons for decline are loss of habitat to housing development and efforts to prevent fires in the chaparral. This latter activity has encouraged the growth of thick stands of brush that are unsuitable for the Morro Bay kangaroo rat.

The giant kangaroo rat inhabits gently rolling terrain having sparse vegetation along the southwestern margin of the San Joaquin Valley and a few adjacent valleys to the west. In the service area, it occurs in the Carrizo Plain, Cuyama Valley, the Elkhorn Plain, and lands near San Joaquin Creek. Ninety-eight percent of its original range is now unoccupied; an area of only 37 square miles remains. Populations of this animal have declined primarily as a result of agricultural land conversions. Rodenticides and trampling of colonies by cattle may also be factors in their decline.

The San Joaquin kit fox occurs in the Cuyama Valley and eastern San Luis Obispo County. The primary reason for its decline is agricultural land conversion.

Air Quality. The Central Coastal service area is located in the South Central Coast Air Basin. No major regional air quality problems exist in the service area at present because it has not experienced large-scale urban growth. Oxidant and ozone concentrations and suspended particulates are the only pollutants that have exceeded the State's ambient air quality standards.

Generally, hydrocarbon and sulfur compound emissions are likely to increase in Santa Barbara County due to offshore oil development and onshore refining of petroleum products. Greatly increased tanker traffic in the Santa Barbara Channel may significantly increase hydrocarbon emissions. In the Santa Maria area, moderate amounts of oil drilling create sulfurous fumes that are a significant air pollution problem at times.

Economic Activity

Government has been one of the leading employment sectors in San Luis Obispo County; however, after the passage of Proposition 13 in 1978, the rate of increase in employment for this sector has declined. In comparison, employment gains in services and trade have been strong in recent years. Retail trade and services accounted for about 46 percent of total wage and salary employment in 1980.

Tourism has played a significant role in the expansion of trade and services employment. San Luis Obispo County, situated along the coast midway between Los Angeles and San Francisco, has a strong appeal to tourists. In 1979, the county ranked 15th in California in terms of travel-generated revenues, with an income of $188 million from this source.

Historically, agriculture has played a significant role in the county's economy, a trend that is expected to continue. In 1980, agricultural employment accounted for about 5.3 percent of total wage and salary employment. Agriculture in San Luis Obispo County consists primarily of livestock, field crops, and vegetables. Total gross farm revenues in 1980 were $159.9 million, placing the county in the 25th rank in the State.

In 1980, services composed the largest percentage of total wage and salary employment in Santa Barbara County--26 percent. The next two largest sectors are trade (23 percent) and government (19 percent). Two large employers, the University of California, Santa Barbara, and Vandenburg Air Force Base, have been important influences. In the next few years, the space shuttle and MX missile programs could significantly increase activity at Vandenburg.

As in San Luis Obispo County, tourism has had a significant role in stimulating local services in Santa Barbara County. The natural beauty of the county's coastline, as well as the amenities offered by its cities (particularly Santa Barbara) attract many visitors. Visitors' expenditures accounted for about 12 percent of the county's labor and proprietors' income in 1980.

Other important sources of revenue for the county include the development of its natural resources (mainly petroleum, natural gas, and diatomite) and agricultural production. A significant share of the State's petroleum resources is located offshore near the city of Santa Barbara.

Almost half the county's land is in agricultural production; in 1980, farm revenues reached $300 million. In the same year, avocados were the county's leading crop, with $55 million in revenues (second in the State), followed by cattle, with about $27 million. Broccoli, lettuce, cauliflower, and celery are also important. Fruits grown in the county include strawberries and lemons. The Lompoc area is the world's leader in the production of flower seeds.

Population

As of 1980, the population of San Luis Obispo County totaled about 156,200, and over the preceding ten years, annual population gains averaged about 5,000 people, or 3.9 percent per year. Over four-fifths of the county's population growth was the result of in-migration, much of which came from Los Angeles County. The Department of Finance projects an average annual population growth of 2.9 percent for the county from 1980 to 1985, or about 4,800 people per year.

Santa Barbara County's large average annual population gains during the 1950s (5.6 percent) and 1960s (4.6 percent) were much reduced during the 1970s, when the county's average annual growth rate was 1.2 percent. In 1980, the county's population was almost 300,000 residents. Growth is expected to continue to be slow because of limited housing, water shortages, limited employment opportunities, and local ordinances restricting growth in some areas.

Table 53 presents estimates of the 1980 Central Coastal service area population and forecasts for 1990, 2000, and 2010.

Water Supply and Demand

Projected Central Coastal service area water supplies, both local and imported, are presented in Table 54. Two SWP levels are shown: one for full SWP entitlement and one with no additional SWP facilities. Table 55 presents projected Central Coastal service area urban and agricultural water demands, with allowances for conservation. Even with full SWP entitlement, water demands in this service area exceed supplies. In 1990, demand exceeds supplies (with full entitlement) by about 89,600 acre-feet; by 2010, the shortage is about 93,800 acre-feet. With reduced SWP entitlement, the shortages even are greater.

Impacts of Future SWP Deliveries

Economic Impacts

The Central Coastal service area's direct, indirect, and induced income and employment impacts between Scenarios 1 and 5 are discussed in the following section. The difference in socioeconomic activity between Scenarios 1 and 5 is the maximum impact that occurs during a dry year. Impacts do not begin until 1990, when the Coastal Branch is assumed to be in operation.

Income. The service area's average annual income impacts are shown in Table 56. During the 1990s, the average annual direct income impacts between Scenarios 1 and 5 are insignificant, but after 2020, they are expected to reach about $200 million (1982 dollars). Statewide, the average annual direct, indirect, and induced income impact is about $1.0 billion after 2020.

Employment. Average annual employment impacts are presented in Table 57. As in the income analysis, the employment impact between Scenarios 1 and 5 is insignificant during the 1990s, but this changes in later years. Beyond 2020, the average annual direct employment impact in the service area between Scenarios 1 and 5 is about 6,400 person-years. Statewide, the average annual reduction in direct, indirect, and induced employment is about 42,400 person-years after 2020.

Social Impacts

Population. Population impacts in the Central Coastal service area are shown in Table 58. During the 1990s, population impacts between Scenarios 1 and 5 are insignificant, but after 2020, the average annual impact is about 20,800 persons.

Housing Units. Housing unit impacts are shown in Table 59. As with population, housing unit impacts are insignificant during the 1990s, but after 2020, the average annual housing unit impact between Scenarios 1 and 5 is about 9,100 units.

Social Services. The impact of increased water supplies on social services in the service area will be mixed. This report indicates increases in income and employment, both at the local (service area) and State levels. As a result, the State and local governments could experience some increase in revenues from taxes and other sources. However, additional socioeconomic activity can also place a strain upon local agencies because they must furnish increased levels of services for this population. Many communities have found growth to be a mixed blessing because the costs of providing services have frequently outstripped revenues.

Environmental Impacts

The delivery of SWP supplies to the Central Coastal service area will affect income and employment in water-related industries. Economic opportunities such as increased income and employment provided by the water supplies will support population and urban development, which in turn affect the environment. Environmental impacts examined below are changes in land use, vegetation, wildlife, and water and air quality.

The scope of this report does not allow for the identification of specific lands that might be converted to urban uses. It is therefore difficult to predict with any degree of certainty where specific impacts will occur in the Central Coastal service area. Environmental values change from one locale to another, and an action that would benefit one area could destroy important values in another.

Land Use. Although urban acreage is expected to increase, agriculture will continue to be the dominant land use in the service area, at least until 2000. No major conversion of agricultural lands to urban uses is foreseen within Santa Barbara County for the next two decades because of the agricultural preserve program under the Williamson Act and because of existing city and county land use and growth policies.

Development has been slowed or even halted in a number of areas within the service area, such as the Solvang-Santa Ynez-Ballard area, the Morro Bay area, and other areas, by present environmental constraints, including water development. These factors have caused a downward revision in expected growth rates. However, if and when these constraints are overcome, rapid growth can be expected. Subsequently, if SWP water were to become available, it could accommodate some of the new users, unless it were used to offset existing deficits and the allocations were strictly enforced.

Water supply has been a significant restraint to the growth of this service area. Moratoriums on new growth in the past have shown that local governments are becoming increasingly aware of water problems such as ground water overdraft, and are seeking to prevent conditions from worsening. Water availability in the future could become a significant factor in determining land use in the area. New water supplies would help ease growth constraints. While future growth rates and the locations in which they will occur is difficult to determine, general plans, zoning ordinances, and growth-management plans all seek to control and contain urban and industrial growth in areas suitable for those purposes.

Most growth in Santa Barbara County is expected to occur along its southern coastal portion in Goleta Valley, Santa Barbara, and the Carpinteria-Summerland areas. Urban expansion is also projected to occur in the Orcutt-Santa Maria area north of Lompoc near Mission Hills, in Mesa Oaks and Vandenburg Village and in the Santa Ynez Valley. Aside from the area north of Lompoc around Burton Mesa, this urban expansion will cause some conversion of prime agricultural lands.

In San Luis Obispo County, the greatest growth is presently taking place in the Los Osos-Baywood area near Atascadero. Urban expansion is also expected around the Arroyo Grande, San Luis Bay, and San Luis Obispo areas where populations are expected to at least double by 2000.

Projected total population, housing unit, and acreage requirements for the Central Coastal service area are shown in Table 60.

Since SWP entitlement in this service area will be used primarily for M&I purposes, it will affect projected land use through its impact upon population and acreages required for housing. SWP deliveries to this service area would not begin until the early 1990s, and impacts associated with the SWP would not begin until then.

Full deliveries of the SWP are estimated to affect about 21,700 persons between 1990 and 1999 (Table 61). By 2010, Scenario 1 deliveries will impact about 31,000 persons. Table 61 also presents the increase in housing units and required acreages associated with this growth in populaton. During the 1990s, SWP Scenario 1 deliveries will impact 9,300 housing units, which would require about 1,290 acres. By 2010, this scenario will impact 13,700 housing units, which would require 1,870 acres.

The relative size of these growth impacts can be determined by comparing them to the increase in total forecasted socioeconomic activity in the Central Coastal service area. For example, total population in the service area from 1980 to 2000 is projected to increase by about 126,500 persons. Therefore, the SWP population impact is about 17.2 percent of this total increase in population (Table 62). By 2010, this increase in SWP population is about 17.7 percent of the total service area population increase.

With reductions in SWP entitlement (Scenarios 2-5), growth associated with the SWP would still occur. Socioeconomic growth is expected to remain relatively constant under all scenarios during the period 1990-1999. After 2000, however, differences between scenarios becomes more apparent and, by 2010, about 20,800 persons, 9,200 housing units, and 1,255 acres would be impacted by Scenario 5 deliveries. These impacts are about 11.9, 9.1, and 7.7 percent of the total service area population, housing unit, and required acreage increases between 1980 and 2010.

In conclusion, urban expansion in the Central Coastal service area is expected to continue to have some significant environmental effects on land use. Since the area does not now receive any SWP supplies, even minimal deliveries to the service area would cause some urban expansion.

Vegetation. SWP deliveries to the Central Coastal service area would cause the loss of some vegetation, open space, and wildlife habitats, primarily because of urban expansion into environmentally sensitive areas. Some vegetation loss would also be directly attributable to delivery system construction.

Modification of the native plant communities in the service area has in the past been limited to the low-lying fertile inland valleys and along the coast. Much of the area's remaining native flora lies within government-controlled areas (Los Padres National Forest and Vandenburg Air Force Base), and therefore has been somewhat protected from major disturbance.

In Santa Barbara County, much of the potential vegetation loss would be due to the conversion of prime agricultural lands to urban lands. Some losses of natural vegetation may also occur along the south coast and in the area north of Lompoc around Barton Mesa, which is recognized as a unique chaparral habitat.

Delivery of SWP water into this service area could have a beneficial long-term impact on riparian habitat and other instream resources, if SWP water were used to replenish ground water aquifers in overdrafted basins. Ground water replenishment could make it possible for riparian growth to re-establish itself.

Most of the natural areas within the service area would not be adversely impacted by future SWP supplies. However, some of these natural areas could be affected because of their proximity to existing urban areas that are projected to grow.

Wildlife. Generally, as increased water supplies become available for industrial and residential development, demand for land to support this growth also increases. This growth can lead to a faunal shift from animals adapted to natural habitats to those that can adapt to human communities.

SWP water deliveries into the service area could have a significant beneficial effect on the fisheries in reservoirs along its distribution route. A new fishery consisting of warmwater nonanadromous fish and invertebrates of the Sacramento-San Joaquin Delta would soon become established in terminal reservoirs. This could significantly add to the area's fisheries and increase recreation potential.

Existing fisheries would also benefit, if seasonal fluctuation in reservoirs is modified in the summer by the addition of the imported water. This would make possible greater reservoir stability and operational flexibility and would benefit species such as sunfish and black bass that depend on shallow shoreline areas for spawning, feeding, and cover.

If SWP deliveries were used in lieu of ground water, the SWP water could also have a positive impact on anadromous fish populations by averting the potentially adverse impacts associated with excessive ground water extractions that lower water tables and reduce instream flow. SWP water could also be used to supplement existing surface flows, thereby tempering the effects of of sedimentation and chemical pollution from both urban and agricultural users on instream fishery resources.

Disturbance and destruction of coastal and inland marshes and riparian areas have in the past impacted a number of sensitive and endangered bird species, including the American peregrine falcon, the light-footed clapper rail, the California least tern, the Belding's savannah sparrow, the California brown pelican, the least Bell's vireo, and the rare California black rail. The greatest threat to these rare and endangered species is the diminution of coastal wetlands. The peregrine falcon uses wetlands for feeding during the winter, while the other species maintain resident and/or nesting populations in these areas. Preservation of remaining coastal wetlands is necessary if these sensitive species are to be protected.

In the Santa Barbara County portion of the service area, two bird species, the Belding's savannah sparrow and the light-footed clapper rail, occur in and around the Carpinteria Marsh and Goleta Slough. In the Carpinteria Marsh area,2/ the greatest threat to these endangered species and other wildlife species comes from urban expansion, while the Goleta Slough area3/ continues to be threatened by airport, road, and recreation expansion, which has already claimed over 60 percent of the original marsh. Delivery and use of SWP supplies could indirectly impact the Belding's savannah sparrow. Urban growth in the service area, whether or not related to the SWP, can be expected to have some impacts to the coastal salt marsh area. Increased recreational pressures, urban runoff, and sedimentation are examples of impacts likely to accompany industrial and residential growth.

Programs to preserve and improve riparian habitat for these sensitive species are under way. Riparian zones are unique and limited resources, and local and county governments have taken

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2/ The Carpinteria Marsh supports significant waterfowl populations averaging over 60,000 duck use-days and over 190,000 shore bird use-days annually (Concept Plan for Wintering Waterfowl Habitat Preservation, U.S. Fish and Wildlife Service, 1979).

3/ Goleta Slough is also heavily used by waterfowl averaging over 150,000 annual use-days (Concept Plan for Wintering Waterfowl Habitat Preservation, U.S. Fish and Wildlife Service, 1979).

steps to preserve those areas through zoning. In fact, many of these areas are already protected because they have been designated as flood hazard areas in which development is restricted. Delivery of SWP supplies is not expected to have any significant growth-related impact on riparian vegetation. Actually, there may be some opportunities for enhancing riparian habitat through instream deliveries of SWP supplies.

Recent surveys in the service area by the Department of Fish and Game (DFG) have shown that populations of the endangered peregrine falcon are slowly recovering. In an effort to improve the falcon's breeding success, the California Fish and Game Commission has established the Morro Rock Ecological Reserve. The Morro Bay area also provides habitat for the California brown pelican, the Morro Bay kangaroo rat, and the California black rail.

Increasing urban growth in the Baywood Park and Los Osos communities near Morro Bay has reduced the available habitat for the Morro Bay kangaroo rat. This could lead to further declines, even though DFG has recently established the 50-acre Morro Dunes Ecological Reserve to preserve essential habitat for this species.

Construction of the Coastal Branch of the California Aqueduct to serve Santa Barbara and San Luis Obispo Counties could have substantial local impacts on vegetation and wildlife. The aqueduct route has not been chosen, but it will generally traverse mountainous and foothill terrain having a high wildlife value.[4/] Studies concerning alternative routes will require careful consideration of all developmental factors, including environmental values.

Hydrology and Water Quality. Even with full SWP entitlement, water demands in the service area are projected to exceed supplies (Tables 54 and 55). If less than full entitlement deliveries are made to the service area, these shortages would be even greater.

Use of SWP supplies to recharge overdrafted ground water basins in the service area would aid in improving overall ground water quantity and quality. This benefit, however, may not be significant since demand is projected to exceed supply and overdrafting is expected to continue.

In addition to ground water recharge benefits, water quality would be improved when SWP water is blended with water supplies of lesser quality. Municipal effluent is not expected to cause any water quality problems in the service area, provided

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4/ See Environmental and Water Resources Reconnaissance Study for SWP and Alternatives, Santa Barbara County Water Agency, January 1979.

that financing is available to upgrade existing water treatment facilities and to construct new ones, where necessary.

As in the other SWP service areas, limited options are available for meeting projected water shortages. Many of the ground water basins are already overdrafted, and efforts to increase conservation above already-projected levels would be difficult and costly. Development of local streams and enlargement of existing reservoirs would also be difficult and costly and would, moreover, significantly affect existing local wildlife habitat and change vegetation, fish, and wildlife composition downstream from these local projects. While these environmental impacts would probably occur to some extent, with or without SWP deliveries, SWP water could preclude a significant portion of future local development and consequently reduce impacts on local environments.

Air Quality. Oxidant concentrations in the service area have been dropping, and it is predicted that, by 1987, the Santa Barbara County portion of the service area will have attained the National Ambient Air Quality Standards for ozone. During 1975, the air quality standard for one-hour concentrations of oxidant was exceeded on 156 days in the South Central Coast Air Basin. In 1980 this occurred on 143 days. It is further expected that the 8-hour standard for carbon monoxide will be attained by 1985. Carbon monoxide concentrations are declining, primarily as a result of emissions restrictions on motor vehicles.

Growth associated with future SWP supplies would contribute to air quality degradation in the local air basin. Because future SWP growth in this service area under Scenario 1 represents almost 20 percent of projected growth by 2010, its contribution may affect future attainment goals.

Table 52: Rare and Endangered Species
Central Coastal Service Area

Scientific Name	Common Name	Status 1/
PLANTS		
Arctostaphylos hookeri ssp. hearstiorum	Hearst's manzanita	SE
Arctostaphylos imbricata	San Bruno Mtn. manzanita	SE
Bloomeria humilis	Dwarf golden star	SR
Ceanothus hearstiorum	Hearst Ranch deer brush	SR
Ceanothus maritimus	Maritime ceanothus	SR
Chorogalum purpureum var. reductum	Camatta Canyon amole	SR
Clarkia speciosa ssp. immaculata	Pismo clarkia	SR
Eriodictyon altissimum	Indian knob mountain balm	SE
Eriodictyon capitatum	Lompoc yerba santa	SR
Sanicula maritima	Adobe snakeroot	SE
Sidalcea hickmanii ssp. anomala	Cuesta Pass checker	SR
Sidalcea hickmanii ssp. parishii	Parish's checker	SR
FISH		
Gasterosteus aculeatus williamsoni	Unarmored threespine stickleback	SR
REPTILES		
Gambelia silus	Blunt-nosed leopard lizard	SE
BIRDS		
Falco peregrinus anatum	American peregrine falcon	SE,FE
Gymnogyps californianus	California condor	SE,FE
Haliaeetus leucocephalus	Bald eagle	SE,FE
Laterallus jamaicensis coturniculus	California black rail	SR
Passerculus sandwishensis beldingi	Belding's savannah sparrow	SE
Pelecanus occidentalis californicus	California brown pelican	SE,FE
Rallus longirostris levipes	Light-footed clapper rail	SE,FE
Sterna albifrons browni	California least tern	SE,FE
Vireo bellii pusillus	Least Bell's vireo	SE
MAMMALS		
Ammospermophilus nelsoni	San Joaquin antelope squirrel	SR
Dipodomys heermanni morroensis	Morro Bay kangaroo rat	SE,FE
Dipodomys ingens	Giant kangaroo rat	SE
Vulpes macrotis mutica	San Joaquin kit fox	SR,FE

1/ FE = Federally listed endangered species.
SE = State listed endangered species.
SR = State listed rare species.

Table 53: Population in the Central Coastal Service Area
1980-2010
(thousands)

SWP Contractor	1980	1990	2000	2010
San Luis Obispo County FCWCD	156.2	199.6	232.6	265.3
Santa Barbara County FCWCD	299.7	329.5	349.8	365.7
Total	455.9	529.1	582.4	631.0

Table 54: Water Supplies in the Central Coastal Service Area
1980 - 2010
(thousands of acre-feet)

Water Source	1980	1990	2000	2010
Local Ground Water	321.2	321.2	321.2	321.2
Local Surface Water	46.6	46.6	46.6	46.6
Waste Water Reclamation	4.0	4.0	4.0	4.0
Tunnel Infiltration	4.3	4.3	4.3	4.3
SWP, Full Entitlement	-	70.5	70.5	70.5
SWP, w/o Additional Facilities	-	[35.0]	[31.6]	[31.6]
Total, Full Entitlement	376.1	446.6	446.6	446.6
Total, w/o Additional Facilities	[376.1]	[411.1]	[407.7]	[407.7]

Source: SWP Recommended Water Management Plans for San Luis Obispo County and Santa Barbara County Flood Control and Water Conservation Districts (drafts), 1982.

Brackets indicate reduced SWP deliveries.

Table 55: Water Demand in the Central Coastal Service Area
1980 - 2010
(thousands of acre-feet)

Water Demand	1980	1990	2000	2010
Urban	107.8	124.9	137.5	149.2
Agricultural	403.5	429.3	424.1	416.3
Conservation (Urban)	-	(7.5)	(12.4)	(14.6)
Conservation (Agricultural)	-	(18.0)	(22.9)	(25.1)
Total	511.3	528.7	526.3	525.8

Source: SWP Recommended Water Management Plans for San Luis Obispo County and Santa Barbara County Flood Control and Water Conservation Districts (drafts), 1982.

Parentheses indicate negative numbers.

Table 56: Average Annual Direct, Indirect, and Induced Income Impact Supported by SWP Firm Deliveries
Central Coastal Service Area
(billions of 1982 dollars)

Impacts Between Scenarios	1980-1989		1990-1999		2000-2009		2010-2019		2020+	
	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced
Scenarios 1 and 2	$0	$0	$0	$0	$0	$0	$0	$0	$0.1	$0.5
Scenarios 2 and 3	0	0	0	0	0	0	0	0	0	0
Scenarios 3 and 4	0	0	0	0	0	0	0	0	0	0
Scenarios 4 and 5	0	0	0	0	0.1	0.5	0.1	0.5	0.1	0.5
Total Impact	0	0	0	0	0.1	0.5	0.1	0.5	0.2	1.0

Table 57: Average Annual Direct, Indirect, and Induced Employment Impact Supported by SWP Firm Deliveries
Central Coastal Service Area
(thousands of person-years)

Impacts Between Scenarios	1980-1989		1990-1999		2000-2009		2010-2019		2020+	
	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced
Scenarios 1 and 2	0	0	0	0	0	0	0	0	1.8	11.9
Scenarios 2 and 3	0	0	0	0	0.3	2.0	1.4	9.3	1.8	11.9
Scenarios 3 and 4	0	0	0	0	1.1	7.2	1.1	7.2	1.0	6.6
Scenarios 4 and 5	0	0	0	0	1.8	12.0	1.8	12.0	1.8	12.0
Total Impact	0	0	0	0	3.2	21.2	4.3	28.5	6.4	42.4

Table 58: Average Annual Population Impact Supported by SWP Firm Deliveries
Central Coastal Service Area
(thousands of persons)

Impacts Between Scenarios	1980-1989	1990-1999	2000-2009	2010-2019	2020+
Scenarios 1 and 2	0	0	0	0	5.9
Scenarios 2 and 3	0	0	1.0	4.6	5.8
Scenarios 3 and 4	0	0	3.3	3.3	3.2
Scenarios 4 and 5	0	0	5.9	5.9	5.9
Total Impact	0	0	10.2	13.8	20.8

Table 59: Average Annual Housing Unit Impact Supported by SWP Firm Deliveries
Central Coastal Service Area
(thousands of units)

Impacts Between Scenarios	1980-1989			1990-1999			2000-2009		
	Total	Single Family	Multiple Family	Total	Single Family	Multiple Family	Total	Single Family	Multiple Family
Scenarios 1 and 2	0	0	0	0	0	0	0	0	0
Scenarios 2 and 3	0	0	0	0	0	0	0.5	0.3	0.2
Scenarios 3 and 4	0	0	0	0	0	0	1.4	0.8	0.6
Scenarios 4 and 5	0	0	0	0	0	0	2.6	1.5	1.1
Total Impact	0	0	0	0	0	0	4.5	2.6	1.9

Impacts Between Scenarios	2010-2019			2020+		
	Total	Single Family	Multiple Family	Total	Single Family	Multiple Family
Scenarios 1 and 2	0	0	0	2.6	1.5	1.1
Scenarios 2 and 3	2.0	1.2	0.8	2.5	1.5	1.0
Scenarios 3 and 4	1.4	0.8	0.6	1.4	0.8	0.6
Scenarios 4 and 5	2.6	1.5	1.1	2.6	1.5	1.1
Total Impact	6.0	3.5	2.5	9.1	5.3	3.8

Table 60: Total Projected Population, Housing Unit, and Acreage Requirements
Central Coastal Service Area

	1980	1990	2000	2010
Population (thousands of persons)	455.9	529.1	582.4	631.0
Housing Units (thousands of units)				
Single Family	138.2	173.2	197.9	213.9
Multiple Family	43.5	53.1	61.9	68.9
Total Housing	181.7	226.3	259.8	282.9
Acreage Requirements (thousands of acres)				
Single Family 1/	27.6	34.6	39.6	42.8
Multiple Family 2/	2.2	2.7	3.1	3.4
Total Acres	29.8	37.3	42.7	46.2

1/ Assumes 1 acre could accommodate 5 single family units.

2/ Assumes 1 acre could accommodate 20 multiple family units.

Table 61: SWP Impacts Above Historical Activity, Central Coastal Service Area[1/]

	1979-1983[2/]	1980-1989			1990-1999			2000-2009		
	SWP Annual Average	Scenario 1	Scenario 4	Scenario 5	Scenario 1	Scenario 4	Scenario 5	Scenario 1	Scenario 4	Scenario 5
Population (thousands of persons)	0	0	0	0	21.7	21.7	21.7	31.0	26.7	20.8
Housing Units (thousands of units)										
Single Family	0	0	0	0	5.5	5.5	5.5	7.9	6.8	5.3
Multiple Family	0	0	0	0	3.8	3.8	3.8	5.8	5.0	3.9
TOTAL	0	0	0	0	9.3	9.3	9.3	13.7	11.8	9.2
Acreage Requirements (thousands of acres)										
Single Family[3/]	0	0	0	0	1.10	1.10	1.10	1.58	1.36	1.06
Multiple Family[4/]	0	0	0	0	0.19	0.19	0.19	0.29	0.25	0.19
TOTAL	0	0	0	0	1.29	1.29	1.29	1.87	1.61	1.25

1/ These impacts are the incremental changes in historical SWP activity caused by SWP scenario deliveries for each decade. Positive numbers represent an incremental increase in SWP historical activity (growth), while negative numbers (in parentheses) represent incremental decreases in SWP historical activity.

2/ These estimates are the total levels of socioeconomic activity affected by SWP average annual deliveries over the period 1979-1983.

3/ Assumes 1 acre could accommodate 5 single family units.

4/ Assumes 1 acre could accommodate 20 multiple family units.

Table 62: SWP Impacts as Percentage of Total Projected Service Area Increase, Central Coastal Service Area[1/]

	1980-1989			1990-1999			2000-2009		
	Scenario 1	Scenario 4	Scenario 5	Scenario 1	Scenario 4	Scenario 5	Scenario 1	Scenario 4	Scenario 5
Population	0	0	0	17.2%	17.2%	17.2%	17.7%	15.2%	11.9%
Housing Units									
Single Family	0	0	0	9.2%	9.2%	9.2%	10.4%	9.0%	7.0%
Multiple Family	0	0	0	20.7	20.7	20.7	22.8	19.7	15.4
OVERALL HOUSING	0	0	0	11.9	11.9	11.9	13.5	11.7	9.1
Acreage Requirements									
Single Family	0	0	0	9.2%	9.2%	9.2%	10.4%	8.9%	7.0%
Multiple Family	0	0	0	21.1	21.1	21.1	24.2	20.8	16.3
OVERALL ACREAGE	0	0	0	10.0	10.0	10.0	11.4	9.8	7.7

1/ This compares the incremental percentage change in socioeconomic activity caused by SWP deliveries with the total incremental change projected in Table 24. Positive numbers represent an incremental percentage increase in SWP historical activity (growth), while negative numbers (in parentheses) represent incremental percentage decreases in SWP historical activity.

CHAPTER V. SOUTH BAY SERVICE AREA

Description and Location

The South Bay service area includes portions of Alameda and Santa Clara counties situated around the southern half of San Francisco Bay. SWP contractors within the service area include the Alameda County Water District (ACWD); the Alameda County Flood Control and Water Conservation District, Zone 7 (Zone 7); and the Santa Clara Valley Water District (SCVWD). Collectively, their contracts provide for the delivery of 188,000 acre-feet of maximum entitlement through the South Bay Aqueduct of the SWP. This water is used primarily for M&I purposes.

Figure 10 shows the location of the South Bay service area. Figure 11 depicts the service area in detail.

Environmental and Socioeconomic Profile

Physical and Biological Environment

Following is a description of the South Bay service area's physical and biological environment. Factors described in this section include climate, vegetation, wildlife, rare and endangered species, and air quality.

Climate. In the South Bay service area, temperature, precipitation, and winds vary greatly due to the area's proximity to the Pacific Ocean and San Francisco Bay. These influences are more significant in northern Santa Clara County and western Alameda County. In eastern Alameda County, their effects diminish. Daily mean maximum temperatures in July range from 80°F near the Bay in northern Santa Clara County to 88°F in the Livermore area of Alameda County. Winter temperatures are more uniform throughout the area, with daily mean temperatures in January of about 65°F.

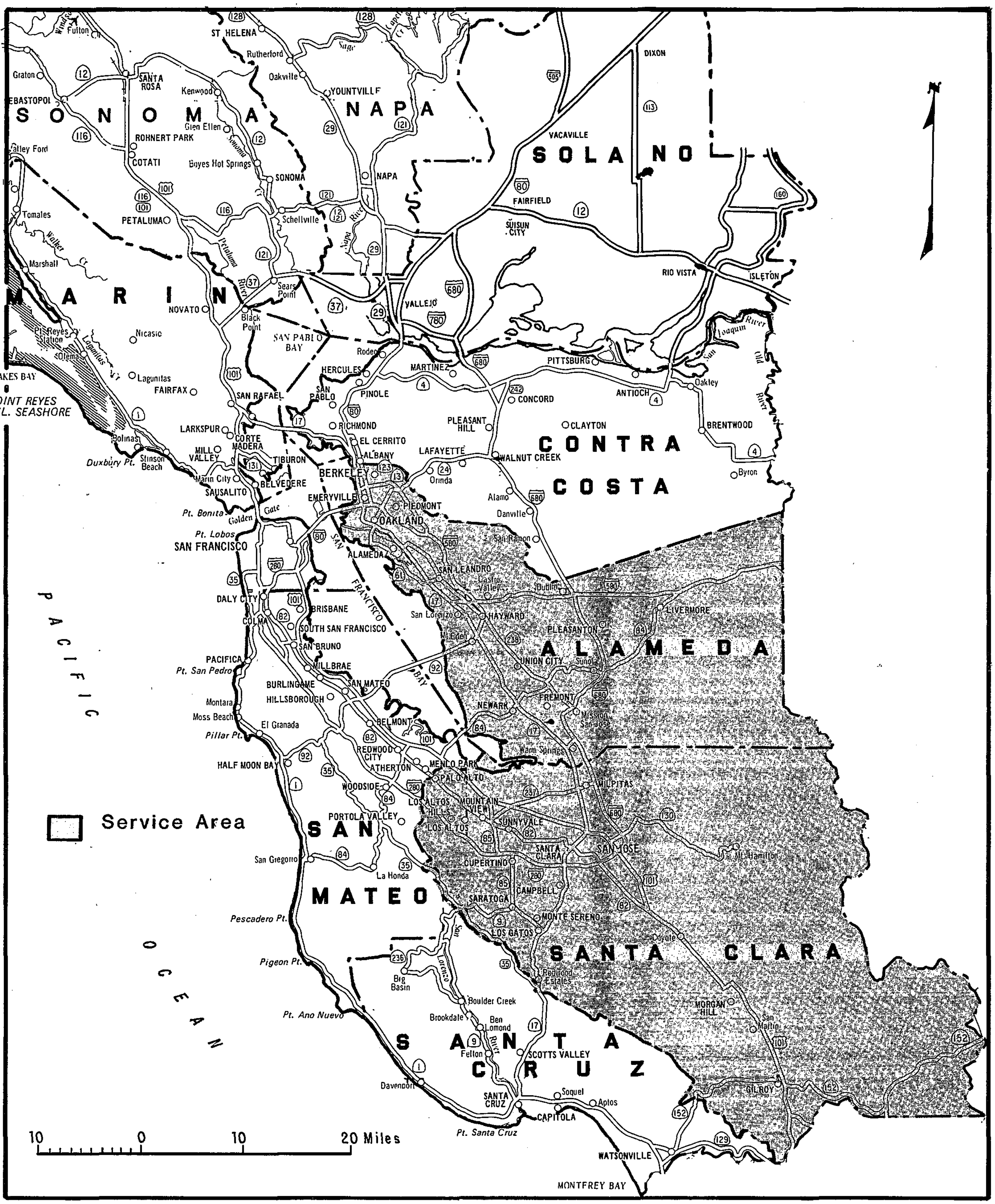
Average annual rainfall ranges from about 16 inches in southern Alameda County to 56 inches in western Santa Clara County (the Santa Cruz Mountains). Dominant winds in the service area reflect the presence of sea breezes and generally blow north-to-northwest and southeast.

Vegetation. Major vegetation communities in the service area include marsh, grassland, foothill woodland, chaparral, and coastal coniferous forest.

Salt marsh is found along the shore of San Pablo Bay and inland wherever upstream saline tidal penetration occurs at the mouth of a stream or river. Salt marsh vegetation grows from sea level to approximately 10 feet above sea level, where rainfall is 15 to 40 inches.

Figure 10.
SOUTH BAY SWP SERVICE AREA
STATE WATER PROJECT CONTRACTORS

Figure 11. SOUTH BAY SERVICE AREA



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Fresh-water marshes extend upland from sea level to about 500 feet above sea level where permanent fresh water or moisture-saturated soil is available. Fresh-water marshes are found around lakes or ponds and along river channels far inland. Fresh-water marsh does not depend on climatic conditions, but rather on the presence of fresh water.

The grassland community is primarily found on valley floors and hillsides up to about 4,000 feet. Originally, grasslands consisted of native perennial bunch grasses. However, these native grasses have been largely replaced by introduced annual species.

Foothill woodland is a community made up of two subtypes: oak woodland and digger pine woodland. It is found on the warm slopes of foothills and valley borders, usually on the east- or south-facing slopes where average rainfall is 15 to 40 inches and there is little or no fog. Summers are hot and dry. The foothill woodland is a tree community, and it may be either dense or open, with a scattering of brush and grassland between the trees.

Chaparral is found on dry slopes and ridges of the Coast Range, where soils are usually rocky, gravelly, or fairly heavy. In these areas, average rainfall is about 14 to 25 inches, and fog is rarely present.

Coastal coniferous forest includes the redwood forest subgroup, which is generally found on the seaward slopes of the Coast Range. It occurs over a wide range in elevation, primarily in areas that receive heavy fog and from 35 to 100 inches of rainfall. Trees in this community are generally very tall and form heavy, dense canopies.

Wildlife. Salt marsh and the transitional zones to fresh-water marsh support a variety of wildlife species, including toads, snakes, songbirds, game birds, raptors, herons, and grebes, and several mammals such as bats, mice, muskrats, and raccoons.

Fresh-water marshes in the service area are populated by amphibian species such as frogs, toads, newts, and salamanders, and reptilian species such as garter snakes and pond turtles. These areas also support many species of songbirds, game birds, and nongame birds. Mammals such as rats support raptors. Other representative mammals include muskrats, minks, otters, and raccoons.

Grasslands in the service area support amphibians such as newts and toads, and reptiles such as rattlesnakes, gopher snakes, skinks, and lizards. Several species of birds can be found in these grasslands, including songbirds, raptors, and scavengers. The grasslands are also an important site for several upland game species such as quail, doves, and pheasants. Rabbits, mice, rats, opossums, coyotes, and bobcats are some of the mammals found here.

Foothill woodland areas support a variety of wildlife, including amphibians such as western and spade foot toads, and reptiles such as common king and gopher snakes and western fence lizards. Birds and mammals of this community include goldfinches, blackbirds, mockingbirds, jays, woodpeckers, quails, vultures, hawks, squirrels, gophers, woodrats, skunks, foxes, coyotes, and deer.

Reptiles found in chaparral communities include those found in foothill woodlands and also rattlesnakes and whiptail and alligator lizards. Birds of this community include sparrows, warblers, jays, quail, hawks, and vultures. Mammals found here include rats, mice, badgers, skunks, foxes, coyotes, mountain lions, and bobcats. The transition zones of the chaparral with foothill woodlands and grassland are the principal habitats of deer.

The mixed evergreen forest is populated by several species of frogs, salamanders, and snakes such as the king and garter snakes. Birds found here include sparrows, warblers, fly-catchers, and woodpeckers. Mammals include mice, rats, bats, shrews, skunks, weasels, deer, and bobcats.

Inland waters of the South Bay service area include warm-water and cold-water streams, canals, ponds, and lakes. The cold-water streams contain native rainbow trout. Warm-water streams, canals, and lakes contain bass, sunfish, catfish, blue-gill, crappie, perch, squawfish, minnows, and suckers. The service area also provides estuarine habitat (salt marshes, tidal flats, artificial surfaces such as riprap and pilings, and benthic zones) for numerous plant, fish, and animal species in San Francisco Bay.

<u>Rare and Endangered Species</u>. According to lists prepared pursuant to the Federal Endangered Species Act (1973) and the California Endangered Species Act (1970), 15 rare or endangered species are known to occur within the service area (Table 63). (All tables referred to in this chapter appear at the end of this chapter.)

<u>Air Quality</u>. The service area lies primarily within the San Francisco Bay Area Air Basin and is included within the jurisdiction of the Bay Area Air Pollution Control District (BAAPCD). In 1980, the BAAPCD operated four air quality monitoring stations in Alameda County at San Leandro, Hayward, Fremont, and Livermore, and four stations in Santa Clara County at San Jose, Los Gatos, San Jose (Piedmont), and Gilroy.

Pollutant trends in the San Francisco Bay area are difficult to ascertain because of the large yearly variations in atmospheric conditions. According to a study of oxidant trends in the Bay area, beginning in 1962, overall oxidant averages rose until 1965, declined until 1969, rose again until 1974 (exceeding the 1965 level), and then declined again in 1975 and 1976. Trends in 1975 and 1976 were downward because climatic conditions were not particularly conducive to oxidant formation.

Oxidants are considered a significant problem in Santa Clara County. Most of the oxidant precursors present in the central and southern portions of the county are generated in the heavily populated areas to the north.

Economic Activity

The primary wage and salary employer in Alameda County is government, with the University of California at Berkeley and the naval facilities at Alameda among the major sources of public employment. However, growth in government employment in the county has been slow over the past decade, and this trend is expected to continue.

Services, the second largest employment category in 1981, accounted for about 20 percent of the county's total wage and salary jobs. Continued growth in services employment is expected, especially in business services, health services, hotels, and miscellaneous automotive services.

Manufacturing was the county's third largest employment source in 1981. Most manufacturing activity is in durable goods (motor vehicle and passenger car bodies), metal cans, internal combustion engines, blast furnaces, and electronic computing equipment. Manufacturing employment declined in the early 1980s, primarily because automotive products were affected by lower demand and because production facilities were relocated outside the San Francisco Bay area. In addition, the nondurable goods sector was adversely affected by an economic downturn and plant closures. Food processing employment is expected to continue declining, although employment in printing and publishing, women's apparel, and rubber and plastics is expected to increase modestly during the 1980s.

Alameda County is also an important transportation center. The port of Oakland is the largest container port on the West Coast, and it is still expanding. Oakland International airport and the western terminus of two major railroads are situated in the county. Finally, Alameda County is the headquarters for Bay Area Rapid Transit (BART) and has an extensive freeway system for the movement of people and goods. In 1981, transportation and public utilities accounted for about 6 percent of the county's total wage and salary employment; this is expected to increase during the 1980s.

The economy of Santa Clara county is dominated by manufacturing (especially in durable goods), services, and trade. Of those workers employed in nonfarm activities, 32 percent are in durable goods manufacturing, 23 percent are in services, and 14 percent are in retail trade. Most durable goods manufacturing in the county is in the electronics industry, consisting of manufacturers of nonelectric machinery, guided missiles and space vehicles, and electrical equipment and instruments. Although these industries are expected to grow (the electronics industry should provide 90 percent of all new jobs within the county's durable goods sector through 1985), the growth rates will likely be lower than in the past. This slow-down in growth will occur for several reasons, including competition from foreign markets; a shortage of high-technology skills in Santa Clara County aggravated by a jobs/housing imbalance; and moves by firms expanding outside the county. Trade and services should also provide strong employment growth into the near future.

Historically, Santa Clara's economy was dominated by agriculture. However, the rapid urban development of the county has displaced much of the farming, which is now carried out in the less-populous southern part of the county. Over the last 20 years, the acreage in fruit, nut, vegetable, and berry crops has dramatically declined. However, nursery stock, cut flowers, and seeds have been introduced, allowing agriculture to continue.

Population

Between 1970 and 1980, the population of Alameda County grew by only 3.2 percent, the smallest percentage increase of any county in the San Francisco Bay area. This small growth was mainly the result of natural increase rather than in-migration. In addition, the county has experienced a population shift, with the northwestern cities (Oakland, Berkeley, Albany, Piedmont, Alameda, and San Leandro) experiencing population declines, while cities in the southern and eastern areas of the county (where SWP water is delivered) registered gains. The California Department of Finance projects annual average growth of 0.4 percent in Alameda County from 1980 to 1990, considerably less than the projected 1.6 percent average yearly gain for the entire State.

Santa Clara County is one of the fastest growing areas in the State, containing one-fourth of the total population of the San Francisco Bay area counties. As a result of Santa Clara's rapidly growing industrial base and its emergence as a major employment center, thousands of new residents have been attracted to the county, primarily the more urbanized northern half of the Santa Clara Valley. Between 1950 and 1980, the population of Santa Clara County has more than quadrupled, and as of January 1, 1981, its population of 1,309,500 made it the fourth most populous county in the State, behind only Los Angeles, Orange, and San Diego Counties.

During the last decade, Santa Clara County gained approximately 20,000 new residents each year, with more than half

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of this amount gained from net in-migration. Almost all the cities in the county grew during the 1970s, with the less urbanized communities in the southern half of the county showing the highest relative growth. San Jose registered a 38-percent population increase during this decade, and now ranks as the fourth largest city in the State, and the 17th most populous city in the United States.

Table 64 presents estimates of the 1980 South Bay service area population (which includes portions of Alameda and Santa Clara Counties), as well as forecasts for 1990, 2000, and 2010. In 1980, the service area population was about 1.5 million; it is expected to reach almost 2.0 million by 2010.

Water Supply and Demand

Table 65 presents South Bay service area water supplies (both local and imported) for 1980 through 2010. Two SWP supplies are shown: one for full SWP entitlement and one with no additional SWP facilities. Projected South Bay service area urban and agricultural water demands, with conservation, from 1980 to 2010 are shown in Table 66. Without full SWP entitlement, demands exceed supplies in all years.

Impacts of Future SWP Deliveries

Economic Impacts

The direct income and employment impacts discussed below are the differences in the South Bay economy between Scenario 1 and Scenarios 2 through 5. Losses to statewide direct, indirect, and induced income and employment are presented. The difference in socioeconomic activity between Scenarios 1 and 5 is the maximum impact that occurs during dry-year conditions.

Income. Average annual income impacts between scenarios are shown in Table 67. During the 1980s, firm yield direct annual income impacts between Scenarios 1 and 5 total about $400 million (1982 dollars). Statewide, the direct, indirect, and induced income impact is about $1.2 billion. Beyond 2020, the firm yield annual direct income impact will increase to about $1.4 billion, and the direct, indirect, and induced income impact will increase to about $4.3 billion per year.

Employment. Average annual employment impacts are shown in Table 68. During the 1980s, the total firm yield annual employment impact is about 8,900 person-years. Statewide, the direct, indirect, and induced employment impact is about 35,100 person-years. Beyond 2020, the firm yield annual direct employment impact between Scenarios 1 and 5 reaches about 36,500 person-years, and the direct, indirect, and induced employment impact is about 143,800 person-years.

Social Impacts

Economic impacts provide aggregate indications of changes in the economic environment of a region; social impacts are indicators of the social well-being of a region. While some social impacts can be quantified (for example, changes in population and housing units), others can not (such as changes in the quality of life).

Population. Population impacts in the South Bay service area are shown in Table 69. During the 1980s, the firm yield annual change in population between Scenarios 1 and 5 is about 3,800 persons. Beyond 2020, the total population impact will increase to about 15,300 persons.

Housing Units. Table 70 presents the housing unit impacts. During the 1980s, the firm yield annual housing unit impact between Scenarios 1 and 5 is about 1,400 units. Beyond 2020, the housing unit impact increases to about 7,100 units.

Social Services. The impact of increased water supplies upon social services in the service area will be mixed. This report indicates increases in income and employment, both at the local (service area) and State levels. As a result, the State and local governments could experience some increase in revenues from taxes and other sources. However, additional socioeconomic activity can also place a strain upon local agencies because they have to furnish the increased levels of services for this population. Many communities have found growth to be a mixed blessing because the costs of providing services have frequently outstripped revenues.

Environmental Impacts

The delivery of SWP supplies to the South Bay service area will affect income and employment in water-related industries. Economic opportunities (increased income and employment) provided by the water supplies will support population and urban development, which in turn will affect the environment. Environmental impacts examined below are changes in land use, vegetation, wildlife, and water and air quality.

The scope of this report does not allow for the identification of specific lands that might be converted to urban uses. It is therefore difficult to predict with any degree of certainty where specific impacts will occur in the South Bay service area. Environmental values change from one locale to another, and an action that would benefit one area could destroy important values in another.

Land Use. In the South Bay service area, urban uses will continue to be the dominant land use. Additional water supplies from the SWP would increase the likelihood that remaining open areas would be converted to urban uses. The most significant measurable impact will be the loss of existing open areas, including undeveloped and vacant urban lands, productive agricultural lands, and uncultivated open spaces.

According to Alameda and Santa Clara County general plans, by 2000 approximately 20 percent of the total land in these counties will be urbanized. About 910,000 acres will remain in open public lands and other areas where cities have taken action to exclude urban development.

In the Livermore Valley of Alameda County, overall land use changes are expected to be considerable by 2000, compared to existing uses. At present the valley contains large areas of agriculture and open space. By 2000, much of this land will probably be put to urban use. The urban growth this area expects to undergo will degrade the agricultural and open space values of the county through residential, industrial, and recreational development.

Projected total population, housing units, and acreage requirements for the South Bay service area are shown in Table 71. The SWP will affect projected land use in the service area primarily through its impact upon population and required acreages for housing.

Comparisons of Scenario 1 impacts with the historical activity associated with the SWP indicates total growth resulting from full deliveries. In the left margin of Table 72 are the socioeconomic impacts that are being measured. In the first column are the average annual total levels of socioeconomic activity affected by SWP deliveries over the period 1979-1983. For example, during this period, a total of about 16,800 persons were affected per year by SWP deliveries. The relative size of this estimate can be determined by comparing it with the total population of the South Bay service area in 1980, or about 1,463,400 persons (from Table 71).

Full deliveries of the SWP between 1980 and 1989 will likely affect an additional 700 persons above the historical average (Table 72). During the 1990s, Scenario 1 deliveries will impact about 3,100 more persons than the historical average, and between 2000-2009, about 4,200 more persons. Table 72 also presents the increase in housing units and required acreages associated with the growth in population. During the 1980s, Scenario 1 will impact an additional 200 housing units, which would require about 40 acres. By 2010, this scenario will impact an additional 3,100 housing units, which would require an additional 580 acres.

The relative size of these growth impacts can be determined by comparing them to the increase in total forecasted socioeconomic activity in the South Bay service area. For example, during the 1980s, the population growth impact of Scenario 1 is about 700 persons. From 1980 to 1990, total population in the service area is projected to increase by about 201,600 persons (from Table 71); therefore, the SWP population impact is about 0.3 percent of this total increase in population. SWP population impact by 2010 increases to about 0.9 percent of the total service area population increase. The percentages for these and other impacts (housing and acreage) are shown in Table 73.

Comparisons of historical averages with Scenario 4 will indicate whether the service area will experience growth or lose activity, if the SWP were to remain at current yield. For the South Bay service area, growth is projected to progressively decrease with less than full deliveries of Scenario 1 (Table 72). With some (Scenario 4) or no additional facilities (Scenario 5), growth is projected to be less than historical averages. This would result in decreases in the amount of land currently associated with SWP deliveries.

In conclusion, urban expansion in the South Bay service area is expected to continue to have some significant environmental effects on land use. Although urban expansion will be associated with some of the SWP scenarios, this SWP-induced expansion will be insignificant. For example, the population growth (and related housing and acreage requirements) associated with the increase in Scenario 1 deliveries between 1980 and 2010 is only about 0.9 percent of the projected total population increase over this same period.

Vegetation. Natural areas in the service area, and the rare or endangered flora which occur in these natural areas, are not expected to be affected by full SWP deliveries (Scenario 1). Urban expansion outside these natural areas associated with Scenario 1 deliveries will, however, result in some vegetation losses. By 2010, Scenario 1 deliveries will result in the loss or replacement of approximately 575 acres of existing vegetation.

Maintaining existing levels of delivery (Scenario 4) or reducing current entitlement (Scenario 5) would not result in additional vegetation losses.

Wildlife. Growth associated with future SWP deliveries (Scenario 1) to the South Bay service area would lead to increased demands for land to support projected growth. By 2010, approximately 580 acres of potential habitat could be lost to urban development.

Increasing urban growth in the Livermore Valley area could reduce the available habitat of the rare Alameda striped racer. However, recognizing the sensitivity of this and other rare species, the Alameda County General Plan has adopted a policy of promoting a development pattern to consolidate urban development and preserve the habitats of rare or endangered species. The Environmental Impact Report for the Livermore-Amador Valley

Planning Unit General Plan also recognizes that adoption of the General Plan will lead to a displacement of and change in existing biotic systems and that growth will further reduce the habitat of the Alameda striped racer. The Department of Fish and Game is maintaining contact with county planners to protect habitat from further human encroachment whenever possible.

Adverse impacts of urban growth on the Alameda striped racer could be avoided or mitigated by the requirements of the California Environmental Quality Act. This act would require Alameda County and local agencies to identify harmful impacts of specific development proposals on this species and to adopt feasible measures to avoid or mitigate such impacts before approving these developments.

Overall growth in the service area has also reduced, and is expected to further reduce, the habitat of the rare San Joaquin kit fox. Increased recreational use of local lakes and reservoirs could displace the endangered bald eagle. It has been sighted in the Bay area, but no nesting sites are known.

Possibilities for wildlife enhancement include instream deliveries of SWP water to preserve riparian habitats and waterfowl enhancement programs in which water is ponded for artificial recharge of ground water basins.

Maintaining existing levels (Scenario 4) or decreasing them (Scenario 5) eliminates the potential for future impacts to wildlife since sufficient water supplies would not be available for additional SWP-associated development.

Hydrology and Water Quality. Ground water overdrafting has become less of a problem since SWP water has been introduced into the service area. Deep subsidence caused by overdrafting has been stopped by SWP deliveries. These trends are expected to continue under Scenario 1, if ground water management programs using SWP supplies for recharge are implemented. These programs would improve ground water quality and prevent additional future subsidence and salt-water intrusion.

Increased deliveries (Scenario 1) to the South Bay service area would expose a greater population to risks associated with trihalomethanes (THM) in SWP water. Without additional treatment or the construction and operation of a Delta facility, levels of THM in drinking water will continue to exceed the federal standards.

Streamflow in Alameda Creek would increase with full entitlement SWP deliveries, affecting riparian vegetation and associated wildlife along the creek.

Without additional SWP facilities, supply shortages are projected for the service area (Tables 65 and 66). Limited options for meeting these shortages are available, including increased ground water pumping, development of additional local surface supplies, or increased conservation above already-projected levels.

Air Quality. Oxidant levels in the service area have been declining since 1975. Carbon monoxide concentrations are also decreasing, primarily as a result of stricter control of motor vehicle emissions. It is projected that federal standards for carbon monoxide will be met by 1987. In the San Francisco Bay Area Air Basin, the maximum concentrations of nitrogen dioxide have remained relatively constant, probably because of an increase in the number of stationary combustive sources and because control of nitric oxide emissions from automobiles has not been as vigorous as the control of other emissions. Growth accommodated by increased SWP deliveries (Scenario 1) in the South Bay service area is not expected to significantly affect air quality. However, while federal standards for ozone and carbon monoxide could potentially be met by 1987, projected overall urban growth in the service area during the 1990s could cause these standards to be exceeded in the future.

Table 63: Threatened, Rare, or Endangered Species
South Bay Service Area

Scientific Name	Common Name	Status
PLANTS		
Amsinckia grandiflora	Large-flowered fiddleneck	SE
Arctostaphylos pallida	Alameda manzanita	SE
Helianthella castanea	Mt. Diablo rock-rose	FT
Pedicularis dudleyi	Dudley's lousewort	SR
Sanicula maritima	Adobe snakeroot	SR
Sanicula saxatilis	Rock snakeroot	SR
REPTILES		
Thamnophis couchi gigas	Giant garter snake	SR
Masticophis lateralis euryxanthus	Alameda striped racer	SR
BIRDS		
Falco peregrinus anatum	American peregrine falcon	SE,FE
Gymnogyps californianus	California condor	SE,FE
Haliaeetus leucocephalus	Bald eagle	SE,FE
Laterallus jamaicensis coturniculus	California black rail	SR
Rallus longirostris obsoletus	California clapper rail	SE,FE
Sterna albifrons browni	California least tern	SE,FE
MAMMALS		
Reithrodontomys raviventris	Salt marsh harvest mouse	SE,FE
Vulpes macrotis mutica	San Joaquin kit fox	SR,FE

1/ SR = State listed rare species.
SE = State listed endangered species.
FT = Federally listed threatened species.
FE = Federally listed endangered species.

Table 64: Population in the South Bay Service Area
1980-2010
(thousands of persons)

SWP Contractor	1980	1990	2000	2010
Alameda County FCWCD, Zone 7	104.4	114.9	132.9	145.9
Alameda County WD	203.0	216.2	221.4	232.0
Santa Clara Valley WD	1,156.0	1,323.9	1,458.4	1,559.2
Total	1,463.4	1,655.0	1,812.7	1,937.1

Table 65: Water Supplies in the South Bay Service Area
1980 - 2010
(thousands of acre-feet)

Water Source	1980	1990	2000	2010
Local Ground Water	77.2	83.7	86.7	86.7
Local Surface Water	67.7	67.7	67.7	67.7
Waste Water Reclamation	0	16.4	18.9	27.6
Hetch Hetchy	64.8	80.7	83.8	86.9
Other Recharge	31.3	31.3	31.3	31.3
San Felipe	0	21.8	66.0	83.3
SWP, Full Entitlement	134.8	160.9	188.0	188.0
SWP, w/o Additional Facilities	[134.8]	[80.0]	[84.8]	[84.8]
Total, Full Entitlement	375.8	462.5	542.4	571.5
Total, w/o Additional Facilities	[375.8]	[381.6]	[439.2]	[468.3]

Source: Department of Water Resources, State Water Project; Recommended Water Management Plans: Alameda County Water District; Alameda County Flood Control and Water Conservation District, Zone 7; and Santa Clara Valley Water District, 1982.

Brackets indicate reduced SWP deliveries.

Table 66: Water Demand in the South Bay Service Area
1980 - 2010
(thousands of acre-feet)

Water Demand	1980	1990	2000	2010
Urban	341.8	451.8	514.5	551.8
Agricultural	38.4	35.6	28.1	23.3
Ground Water Recharge	7.6	10.0	10.0	10.0
Quarries	8.0	8.0	8.0	8.0
Conservation (Urban)	-	(37.3)	(61.1)	(69.8)
Total	395.8	468.1	499.5	523.3

Source: Department of Water Resources, State Water Project; Recommended Water Management Plans: Alameda County Water District; Alameda County Flood Control and Water Conservation District, Zone 7; and Santa Clara Valley Water District, 1982.

Parentheses indicate negative numbers.

Table 67: Average Annual Direct, Indirect, and Induced Income Impacts Supported by SWP Firm Deliveries
South Bay Service Area
(billions of 1982 dollars)

Impacts Between Scenarios	1980-1989		1990-1999		2000-2009		2010-2019		2020+	
	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced
Scenarios 1 and 2	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$0.2	$ 0.8	$0.4	$ 1.2
Scenarios 2 and 3	0	0	0.2	0.7	0.2	0.7	0.2	0.7	0.2	0.7
Scenarios 3 and 4	0.4	1.2	0.4	1.2	0.4	1.2	0.4	1.2	0.4	1.2
Scenarios 4 and 5	0	0	0.1	0.5	0.2	0.8	0.4	1.2	0.4	1.2
Total Impact	0.4	1.2	0.7	2.4	0.8	2.7	1.2	3.9	1.4	4.3

Table 68: Average Annual Direct, Indirect, and Induced Employment Impacts Supported by SWP Firm Deliveries
South Bay Service Area
(thousands of person-years)

Impacts Between Scenarios	1980-1989		1990-1999		2000-2009		2010-2019		2020+	
	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced
Scenarios 1 and 2	0	0	0	0	0	0	4.1	16.2	8.6	33.9
Scenarios 2 and 3	0	0	6.0	23.7	8.4	33.1	8.4	33.1	8.4	33.1
Scenarios 3 and 4	8.9	35.1	9.8	38.6	9.8	38.6	9.7	38.2	9.8	38.6
Scenarios 4 and 5	0	0	2.8	11.0	4.2	16.5	8.4	33.1	9.7	38.2
Total Impact	8.9	35.1	18.6	73.3	22.4	88.2	30.6	120.6	36.5	143.8

C-095248

Table 69: Average Annual Population Impact Supported by SWP Firm Deliveries
South Bay Service Area
(thousands of persons)

Impacts Between Scenarios	1980-1989	1990-1999	2000-2009	2010-2019	2020+
Scenarios 1 and 2	0	0	0	1.7	3.6
Scenarios 2 and 3	0	2.5	3.5	3.5	3.5
Scenarios 3 and 4	3.8	4.1	4.1	4.1	4.1
Scenarios 4 and 5	0	1.2	1.8	3.5	4.1
Total Impact	3.8	7.8	9.4	12.8	15.3

Table 70: Average Annual Housing Unit Impact Supported by SWP Firm Deliveries
South Bay Service Area
(thousands of units)

Impacts Between Scenarios	1980-1989			1990-1999			2000-2009		
	Total	Single Family	Multiple Family	Total	Single Family	Multiple Family	Total	Single Family	Multiple Family
Scenarios 1 and 2	0	0	0	0	0	0	0	0	0
Scenarios 2 and 3	0	0	0	1.0	0.7	0.3	1.6	1.3	0.3
Scenarios 3 and 4	1.4	1.2	0.2	1.6	1.3	0.3	1.9	1.6	0.3
Scenarios 4 and 5	0	0	0	0.4	0.4	0	0.8	0.7	0.1
Total Impact	1.4	1.2	0.2	3.0	2.4	0.6	4.3	3.6	0.7

Impacts Between Scenarios	2010-2019			2020+		
	Total	Single Family	Multiple Family	Total	Single Family	Multiple Family
Scenarios 1 and 2	0.8	0.7	0.1	1.7	1.4	0.3
Scenarios 2 and 3	1.6	1.3	0.3	1.6	1.3	0.3
Scenarios 3 and 4	1.9	1.6	0.3	1.9	1.6	0.3
Scenarios 4 and 5	1.6	1.4	0.2	1.9	1.6	0.3
Total Impact	5.9	5.0	0.9	7.1	5.9	1.2

Table 71: Total Population, Housing Unit, and Acreage Requirements
South Bay Service Area

	1980	1990	2000	2010
Population				
(thousands of persons)	1,463.4	1,665.0	1,812.7	1,937.1
Housing Units				
(thousands of units)				
Single Family	86.3	105.1	118.6	125.2
Multiple Family	7.3	9.7	11.6	12.7
Total Housing	93.6	114.8	130.2	137.9
Acreage Requirements				
(thousands of acres)				
Single Family 1/	17.3	21.0	23.7	25.0
Multiple Family 2/	0.4	0.5	0.6	0.6
Total Acres	17.7	21.5	24.3	25.6

1 Assumes 1 acre could accommodate 5 single family units.

2/ Assumes 1 acre could accommodate 20 multiple family units.

Table 72: SWP Impacts Above Historical Activity, South Bay Service Area[1/]

	1979-1983[2/] SWP Annual Average	1980-1989 Scenario 1	1980-1989 Scenario 4	1980-1989 Scenario 5	1990-1999 Scenario 1	1990-1999 Scenario 4	1990-1999 Scenario 5	2000-2009 Scenario 1	2000-2009 Scenario 4	2000-2009 Scenario 5
Population (thousands of persons)	16.8	0.7	(3.1)	(3.1)	3.1	(3.5)	(4.7)	4.2	(3.5)	(5.3)
Housing Units (thousands of units)										
Single Family	5.2	0.2	(1.0)	(1.0)	0.9	(1.1)	(1.5)	2.8	(0.1)	(0.8)
Multiple Family	1.3	0	(0.2)	(0.2)	0.3	(0.3)	(0.3)	0.3	(0.3)	(0.4)
TOTAL	6.5	0.2	(1.2)	(1.2)	1.2	(1.4)	(1.8)	3.1	(0.4)	(1.2)
Acreage Requirements (thousands of acres)										
Single Family[3/]	1.04	0.4	0.2	(0.2)	0.18	(0.22)	(0.3)	0.56	(0.02)	(0.16)
Multiple Family[4/]	0.07	0	(0.01)	(0.01)	0.02	(0.02)	(0.02)	0.02	(0.02)	(0.02)
TOTAL	1.11	0.4	(0.21)	(0.21)	0.2	(0.24)	(0.32)	0.58	(0.04)	(0.18)

1/ These impacts are the incremental changes in historical SWP activity caused by SWP scenario deliveries for each decade. Positive numbers represent an incremental increase in SWP historical activity (growth), while negative numbers (in parentheses) represent incremental decreases in SWP historical activity.

2/ These estimates are the total levels of socioeconomic activity affected by SWP average annual deliveries over the period 1979-1983.

3/ Assumes 1 acre could accommodate 5 single family units.

4/ Assumes 1 acre could accommodate 20 multiple family units.

Table 73: SWP Impacts As Percentage of Total Projected Service Area Increase, South Bay Service Area[1/]

	1980-1989			1990-1999			2000-2009		
	Scenario 1	Scenario 4	Scenario 5	Scenario 1	Scenario 4	Scenario 5	Scenario 1	Scenario 4	Scenario 5
Population	0.3%	(1.5%)	(1.5%)	0.9%	(1.0%)	(1.3%)	0.9%	(0.7%)	(1.1%)
Housing Units									
Single Family	1.1%	(5.3%)	(5.3%)	2.8%	(3.4%)	(4.6%)	7.2%	(0.3%)	(2.1%)
Multiple Family	0	(8.3)	(8.3)	7.0	(7.0)	(7.0)	5.6	(5.6)	(7.4)
OVERALL HOUSING	0.9	(5.7)	(5.7)	3.3	(3.8)	(4.9)	7.0	(0.9)	(2.7)
Acreage Requirements									
Single Family	1.1%	(5.4%)	(5.4%)	2.8%	(3.4%)	(4.7%)	7.3%	(0.3%)	(2.1%)
Multiple Family	0	(10.0)	(10.0)	7.5	(7.5)	(7.5)	7.5	(7.5)	(10.0)
OVERALL ACREAGE	1.1	(5.5)	(5.5)	3.0	(3.6)	(4.8)	7.3	(0.4)	(2.3)

1/ This compares the incremental percentage change in socioeconomic activity caused by SWP deliveries with the total incremental change projected in Table 24. Positive numbers represent an incremental percentage increase in SWP historical activity (growth), while negative numbers (in parentheses) represent incremental percentage decreases in SWP historical activity.

CHAPTER VI. NORTH BAY SERVICE AREA

Description and Location

The North Bay service area is located at the northern end of San Francisco Bay. Included in this service area are the Napa County Flood Control and Water Conservation District (FCWCD), which encompasses all of Napa County, and the Solano County FCWCD, which encompasses all of Solano County. Collectively, these SWP contractors will receive a maximum entitlement of 67,000 acre-feet, which will be used primarily for M&I purposes.

Figure 12 shows the location of the North Bay service area. Figure 13 depicts the service area in detail.

Environmental and Socioeconomic Profile

Physical and Biological Environment

Following is a description of the physical and biological environment in the North Bay service area. Factors described in this section include climate, vegetation, wildlife, rare and endangered species, and air quality.

Climate. The climate of the North Bay service area is influenced by a number of factors, including topography, proximity to the Pacific Ocean, a semipermanent high-pressure system, and frequent cyclonic winter storm systems. Temperatures, rainfall, and winds can vary greatly within short distances. Daily mean high temperatures in July range from 80°F in Vallejo to 96°F in Vacaville. Winter temperatures are more evenly distributed, with a daily mean high temperature of about 56°F throughout the service area.

Average annual rainfall ranges from about 16 inches in western Solano County to 33 inches in St. Helena. Dominant winds in the service area, which reflect the presence of sea breezes, blow generally from the south or southwest.

Vegetation. Major vegetation communities in the service area include marsh, grassland, foothill woodland, chaparral, and coastal coniferous forest.

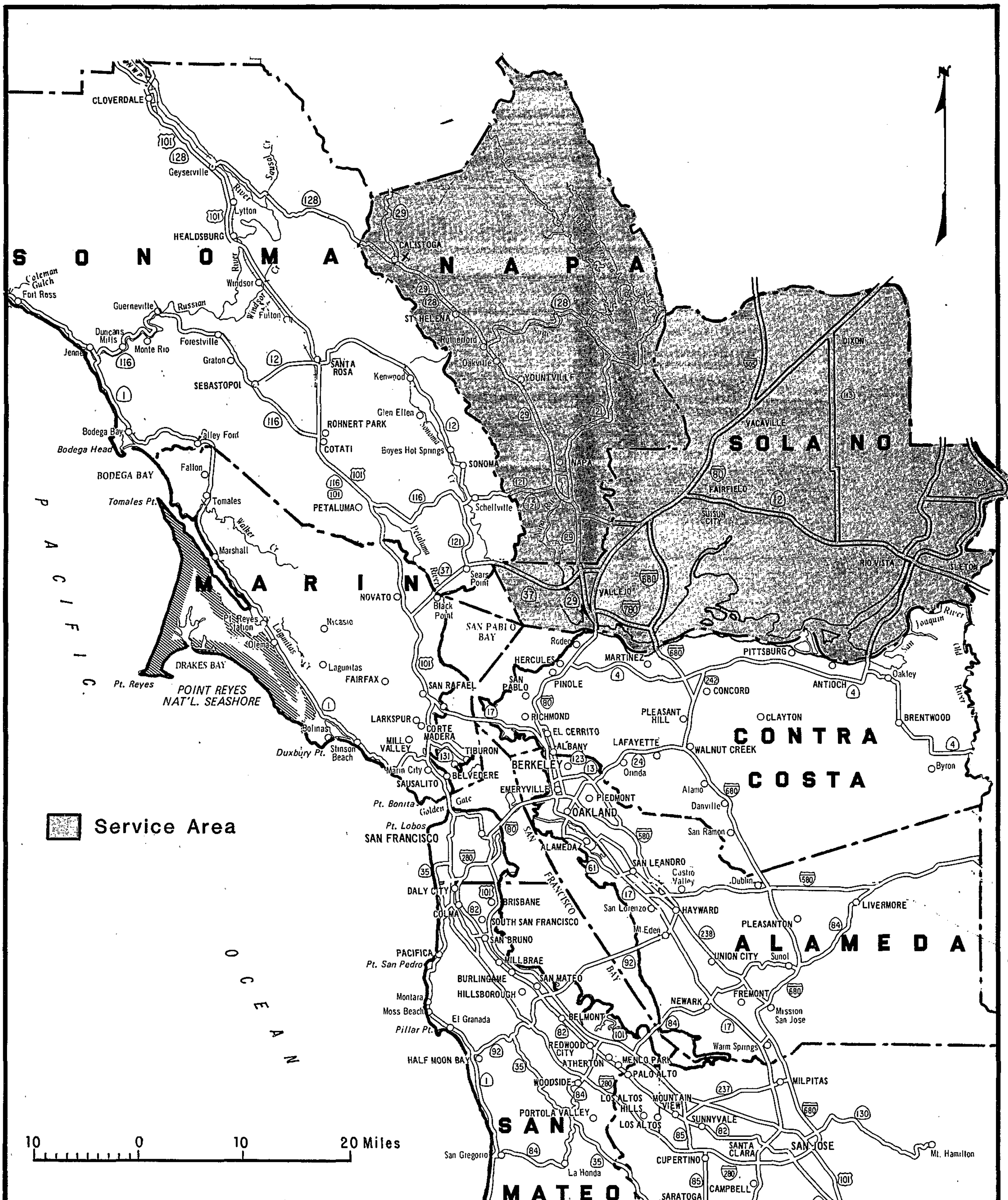
Salt marsh vegetation is found along the shore of San Pablo Bay and inland wherever upstream saline tides enter the mouth of a stream or river. Salt marsh is usually found from sea level to approximately 10 feet above sea level, where annual rainfall is 15 to 40 inches.

Fresh-water marshes extend upland from sea level to about 500 feet, where permanent fresh water or moisture-saturated soil is available. The marshes are found around lakes and ponds and along river channels far inland. Fresh-water marsh is not

Figure 12.
NORTH BAY SWP SERVICE AREA
STATE WATER PROJECT CONTRACTORS

C-095254

Figure 13. NORTH BAY SERVICE AREA



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dependent upon climatic conditions but rather on the presence of fresh water.

Grassland is a community made up of two subtypes: oak woodland and digger pine woodland. It is found on the warm slopes of foothills and valley borders, usually on the east- or south-facing slopes where average annual rainfall is 15 to 40 inches and there is little or no fog. Summers there are hot and dry. The foothill woodland is a tree community, and it may be dense or open, with a scattering of brush and grassland between the trees.

Chaparral is found on dry slopes and ridges of the Coast Range, where soils are usually rocky, gravelly, or fairly heavy. In these areas, average annual rainfall is about 14 to 25 inches, and fog is rarely present.

Coastal coniferous forest includes the redwood forest subgroup, which is generally found on the seaward slopes of the Coast Range. It occurs over a wide range in elevation, primarily in areas which receive heavy fog and somewhere between 35 to 100 inches of rainfall. Trees in this community are generally very tall and form heavy, dense canopies.

Wildlife. Salt marsh and the transitional zones of fresh water marsh support a variety of wildlife species, including toads, snakes, songbirds, game birds, raptors, herons, grebes, and several mammals, such as bats, mice, muskrats, and raccoons.

Fresh-water marshes in the service area are populated by amphibian species such as frogs, toads, newts, salamanders, and reptilian species such as garter snakes and pond turtles. These areas also support many species of songbirds, game birds, and nongame birds. Mammals such as rats support raptors. Other representative mammals are muskrats, minks, otters, and raccoons.

Grasslands in the service area support amphibians such as newts and toads, and reptiles such as rattlesnakes, gopher snakes, skinks, and lizards. Several species of birds can be found in these grasslands, including songbirds, raptors, and scavengers. The grasslands are also an important site for several upland game species such as quail, doves, and pheasants. Rabbits, mice, rats, opossums, coyotes, and bobcats are some of the mammals found here.

Foothill woodland areas support a variety of wildlife, including amphibians such as western and spade foot toads, and reptiles such as common king and gopher snakes and western fence lizards. Birds and mammals of this community include goldfinches, blackbirds, mockingbirds, jays, woodpeckers, quail, vultures, hawks, squirrels, gophers, woodrats, skunks, foxes, coyotes, and deer.

Reptiles found in chaparral communities include those found in foothill woodlands and also rattlesnakes and whiptail and alligator lizards. Birds of this community include sparrows, warblers, jays, quail, hawks, and vultures. Mammals found here include rats, mice, badgers, skunks, foxes, coyotes, mountain lions, and bobcats. The transition zones of the chaparral with foothill woodlands and grassland are the principal habitats of deer.

The mixed evergreen forest is populated by several species of frogs, salamanders, and snakes such as the king and garter snakes. Birds found here include sparrows, warblers, flycatchers, and woodpeckers. Mammals include mice, rats, bats, shrews, skunks, weasels, deer, and bobcats.

The inland waters of the service area support warm-water species such as bass, catfish, bluegill, crappie, perch, squawfish, minnows, and suckers. Spawning habitat for several anadromous species, including trout, bass, salmon, shad, and sturgeon, is provided in the Napa River and the tidal channels of the Sacramento-San Joaquin Delta. Estuarine habitat (salt marshes, tidal flats, artificial surfaces such as riprap and pilings, and benthic zones) for numerous plant, fish, and animal species are provided in San Francisco Bay.

Rare and Endangered Species. According to lists prepared pursuant to the Federal Endangered Species Act (1973) and the California Endangered Species Act (1970), 11 rare or endangered species are known to occur within the service area (Table 74). (All tables referred to in this chapter appear at the end of this chapter.)

Air Quality. The service area lies primarily within the San Francisco Bay Area Air Basin and is included within the jurisdiction of the Bay Area Air Pollution Control District (BAAPCD). The BAAPCD operates three monitoring stations within the service area: Napa, Fairfield, and Vallejo. There are also monitoring stations in Vacaville and Rio Vista (Sacramento Valley Air Basin).

Pollutant trends in the San Francisco Bay area are difficult to ascertain because of the large yearly variations in atmospheric conditions. According to a study of oxidant trends in the Bay area, beginning in 1962, overall oxidant averages rose until 1965, declined until 1969, rose again until 1974 (exceeding the 1965 level), and then declined again in 1975 and 1976. Trends in 1975 and 1976 were downward because atmospheric conditions were not particularly conducive to oxidant formation.

Economic Activity

Agriculture has traditionally been important to the economies of Napa and Solano Counties. Gross cash farm receipts totaled nearly $220 million in 1980. The leading farm products included wine grapes, sugar beets, tomatoes, wheat, and field corn. During the 1980s, the leading crops are expected to be fruit, nut, field, and seed crops.

Napa County is well known for its quality wines. More than 80 wineries are located in the Napa Valley, and their products are distributed worldwide. Because many of the area's wineries offer public tours, the Napa Valley is also a popular tourist attraction.

Although agriculture makes a significant contribution to both counties, farm workers accounted for only about 5.1 percent of total employment in 1981. This figure was 5.4 percent in the 1970s. The decline in agriculture's share of total employment is the result of strong job gains in government, services, and trade, which are the major employment sectors in the two counties. In 1972, more than 33 percent of all workers were employed in the service or trade industries; by 1981, this percentage had increased to 40 percent. These sectors are expected to continue growing into the 1980s.

Government employment accounted for about 32 percent of total wage and salary employment in 1981, with most government workers engaged in defense activities at Mare Island Naval Shipyard and Travis Air Force Base. With defense spending projected to increase in the 1980s, these two facilities should provide additional job opportunities.

Manufacturing for the two counties accounted for about 10.3 percent of total employment in 1981. Most manufacturing jobs are located in the metal fabrication and food processing industries.

Current projections indicate an increase of 20,000 jobs in the two counties between 1980 and 1985. Because of projected population growth, the trade and services sectors are expected to register significant employment gains. Several electronics firms have indicated an interest in relocating to this area, and manufacturing may realize a 17-percent gain in employment between 1980 and 1985. Over this same period, the number of agricultural jobs is expected to increase by about 5 percent.

Population

The combined population of Napa and Solano Counties grew at an annual 2.9 percent rate through the 1970s, reaching about 337,400 residents by 1980. About two-thirds of this gain has been accounted for by net in-migration. Most residents came from the urban counties of the San Francisco Bay area. Department of Finance' projections indicate that the counties' 2.9 percent average annual growth rate should be maintained through the 1980s, outpacing the State's projected population growth rate of 1.6 percent. However, Napa County has imposed ordinances in selected areas to prevent uncontrolled growth. These ordinances may slow in-migration to some communities. Table 75 presents estimates of the 1980 North Bay service area population, as well as forecasts for 1990, 2000, and 2010.

Water Supply and Demand

Table 76 presents North Bay service area water supplies (both local and imported) for 1980 through 2010. Two supplies are shown: one for full SWP entitlement and one with no additional SWP facilities. Projected North Bay service area urban water demands (with conservation) are shown in Table 77. Agricultural water demands were not estimated.

Impacts of Future SWP Deliveries

Economic Impacts

The economic consequences resulting from the delivery of SWP supplies to the North Bay service area are presented in the following section. Included are the direct, indirect, and induced income and employment impacts. The difference in socioeconomic activity between Scenarios 1 and 5 is the maximum impact that occurs during a dry year.

Income. The firm yield annual income impacts between scenarios are shown in Table 78. Up through 2009, the impacts are insignificant, but beyond 2020, the firm yield annual direct income impact (between Scenario 1 and 5) reaches about $300 million (1982 dollars). Statewide, the firm yield direct, indirect, and induced impact is about $1.5 billion.

Employment. Average firm yield employment impacts are shown in Table 79. As in the income analysis, the employment impact is insignificant through 2009, but beyond 2020, the firm yield annual direct impact is about 5,300 person-years. Statewide, the total direct, indirect, and induced impact is about 43,600 person-years.

Social Impacts

Changes in North Bay population and housing units resulting from future SWP deliveries are discussed in the following sections.

Population. Up through 2009, the population impact (between Scenarios 1 and 5) is insignificant, but beyond 2020, the average annual impact is about 5,000 persons (Table 80).

Housing Units. As with population, housing unit impacts are insignificant up to 2009, but beyond 2020, the average annual housing unit impact is about 2,100 units (Table 81).

Social Services. The impact of increased water supplies on social services in the service area will be mixed. This report indicates increases in income and employment, both at the local (service area) and State levels. As a result, the State and local governments could experience some increase in revenues from taxes and other sources. However, additional socioeconomic activity can also place a strain upon local agencies because they have to furnish the increased levels of services for this population. Many communities have found growth to be a mixed blessing because the costs of providing services have frequently outstripped revenues.

Environmental Impacts

The delivery of SWP supplies to the North Bay service area will affect income and employment in water-related industries. Economic opportunities provided by the water supplies (such as increased income and employment) will support population and urban development, which in turn affects the environment. Environmental impacts examined below are changes in land use, vegetation, wildlife, and water and air quality.

The scope of this report does not allow for the identification of specific lands that might be converted to urban uses. It is therefore difficult to predict with any degree of certainty where specific impacts will occur in the North Bay service area. Environmental values change from one locale to another, and an action that would benefit one area could destroy important values in another.

Land Use. According to county general plans, urban uses will continue around existing urban centers. This future growth will result in several measurable environmental impacts, including loss of existing open areas such as undeveloped and vacant urban areas and areas presently zoned as agricultural and open space.

In Solano County, population growth is expected around Suisun City, Fairfield (including Cordelia), and Vacaville. Urban expansion around the Cordelia and Green Valley areas could adversely impact some of the sensitive archeological values there. Additional development in northeastern Fairfield and western Suisun City would cause the conversion of prime agricultural lands. Local regulations to prevent the loss of these prime lands in Solano County are limited, and the extent to which these lands will be permanently lost in the next 20 years will depend on local economics, other developmental constraints, and the presence of any additional regulatory controls. Population growth in Napa County is not expected to be as extensive as in Solano; therefore developmental pressures would be less. With less pressure, existing local growth-control ordinances and land use restrictions are expected to keep present and future land uses under tighter control.

Projected total population, housing unit, and acreage requirements for the North Bay service area are shown in Table 82. The SWP will affect projected land use in the service area, primarily through its impact upon population and required acreages for housing.

Comparisons of Scenario 1 impacts with the historical activity associated with the SWP indicates total growth resulting from full deliveries. In the left margin of Table 83 are the socioeconomic impacts that are being measured. The first column presents the average annual total levels of socioeconomic activity affected by SWP deliveries over the period 1979-1983. For example, during this period, a total of about 700 persons were affected per year by SWP deliveries. The relative size of this estimate can be determined by comparing it with the total population of the North Bay service area in 1980, or about 332,900 persons (from Table 82).

Between 1980 and 1989, full deliveries of the SWP are expected to affect an additional 500 persons above the historical average (Table 83). During the 1990s, Scenario 1 deliveries will affect about 2,800 more persons than the historical average, and between 2000-2009, about 3,700 more persons. Table 83 also presents the increase in housing units and required acreages associated with the growth in population. During the 1980s, Scenario 1 will affect an additional 200 housing units, which would require about 40 acres. By 2010, this scenario will affect an additional 1,500 housing units, which would require an additional 270 acres.

The relative size of these growth impacts can be determined by comparing them to the increase in total forecasted socioeconomic activity in the North Bay service area. For example, during the 1980s, the population growth impact of Scenario 1 is about 500 persons. From 1980 to 1990, total population in the service area is projected to increase by about 114,300 persons (Table 83); therefore, the SWP population impact is about 0.4 percent of this total increase in population. By 2010, the increase in SWP population is about 1.2 percent of the total service area population increase. The percentages for the other impacts (housing and acreage) are similar to those for population. These percentages are shown in Table 84.

Comparisons of historical averages with Scenario 4 will indicate whether the service area will experience growth or lose activity, if the SWP were to remain at current yield. For the North Bay service area, growth under all scenarios is projected to be the same up to 2010. Even if no additional facilities are added (Scenario 5), some growth is projected to occur, although at lower levels beyond 2000.

In conclusion, urban expansion in the North Bay service area is expected to continue to have some significant environmental effects on land use. Although urban expansion will be

C-095261

associated with all the SWP scenarios, this SWP-induced expansion will be insignificant. For example, the population growth (and related housing and acreage requirements) associated with the increase in Scenario 1 deliveries between 1980 and 2010 is only about 1.2 percent of the projected total population increase over this same period.

Vegetation. Development in Suisun City could put additional pressure on the adjacent Suisun Marsh. However, even if all growth associated with the SWP were to be concentrated in this area, recent establishment of the marsh as a preserve should provide substantial buffering and protection. None of the natural areas or their rare or endangered flora would be affected by increased deliveries from the SWP.

Increasing urban expansion associated with SWP deliveries will displace and change existing vegetation. By 2020, from 340 to 185 acres (Scenarios 1-5) of existing vegetation will be lost or replaced by new species that can adapt to the changed conditions. Continued urban growth in uncultivated open space areas will accelerate the change from natural species to introduced species.

Wildlife. Growth associated with future SWP deliveries to the North Bay service area would increase demands for land to support projected growth. Development of land for industrial and residential uses would cause a faunal shift from animals adapted to natural habitats to those species that can adapt to human communities. The loss of natural habitat resulting from growth associated with SWP deliveries, however, would not be significant in terms of overall amounts of land lost. Land conversions resulting from growth associated with full SWP deliveries would be less than 1.0 percent of the overall projected growth for the area. Even with reductions in entitlement (Scenario 5), some growth and some subsequent effects to wildlife could be associated with SWP deliveries.

Possibilities for wildlife enhancement include instream deliveries of SWP water to preserve riparian habitats. The Department of Water Resources is presently improving habitat in the Suisun Marsh as part of its mitigative measures for the SWP. This activity can be expected to continue.

Increased recreational use of local lakes and reservoirs could displace the bald eagle, an endangered species. Bald eagle sightings have occurred in the Bay area, although no known nesting sites exist. Growth in this service area associated with SWP entitlement will not affect other listed species.

Increased urban growth around Suisun City, Fairfield, and Vacaville would substantially increase traffic congestion and elevate ambient noise levels throughout the area. The congestion and noise would adversely impact the urban fringe environments and generally diminish the open space and wildlife value of these lands.

<u>Hydrology and Water Quality</u>. Ground water overdrafting would become less of a problem as SWP water deliveries are increased.

If future SWP entitlement were reduced in the North Bay service area, water supply shortages can be expected after 2010 (see Tables 76 and 77). A few options are available for meeting these shortages, including increased ground water pumping, development of additional local surface supplies, or increased conservation above already-projected levels. Greater reliance on ground water supplies could lead to overdrafting of ground water basins, which would increase the potential for salt-water intrusion problems in Solano County. Development of local streams and enlargement of existing reservoirs would affect existing local wildlife habitat and change vegetation, fish, and wildlife composition downstream from the local projects. Conservation has already been considered in water demand/supply balances (Table 77). Any additional conservation would be more difficult to implement and more expensive, and may also result in potentially adverse social and environmental effects.

Increased urban growth could lead to degradation of surface and ground water by urban runoff. Higher runoff from urban areas will increase the pollutant load reaching the receiving water, with the highest concentrations of pollutants occurring during major storms early in the season.

<u>Air Quality</u>. The North Bay service area is a nonattainment area for ozone and carbon monoxide.

The ozone problem is the most significant in this air basin. To bring the existing high levels of ozone into the attainment range by 1987, the following control measures have been proposed:

- Continued implementation of California's motor vehicle standards on new vehicles.
- An inspection program to reduce pollution from in-use vehicles.
- Increased control of industrial sources.
- Transportation measures to reduce the use of automobiles.
- A program to ensure that, at least until after 1982, new industrial sources be prevented from aggravating existing conditions.

The emission standards for carbon monoxide are also expected to be reached by 1987. Since full SWP deliveries are not expected to begin until sometime after 1990, emission levels for all air quality parameters are expected to be at or below State and federal standards. However, as growth continues, this declining trend may be reversed, unless further controls are implemented after 1990.

Growth associated with future SWP supplies would contribute to air quality degradation in the local air basin. However, this contribution is not significant in comparison to overall growth projections for the area.

C-095264

Table 74: Rare and Endangered Species
North Bay Service Area

Scientific Name	Common Name	Status 1/
PLANTS		
Cordylanthus mollis ssp. mollis	Soft-haired birds beak	SR
Poa napensis	Napa bluegrass	SE
FISH		
Syncaris pacifica	California freshwater shrimp	SE
INVERTEBRATES		
Elaphrus viridis	Delta green ground beetle	FE
REPTILES		
Thamnophis couchi gigas	Giant garter snake	SR
BIRDS		
Falco peregrinus anatum	American peregrine falcon	SE,FE
Haliaeetus leucocephalus	Bald eagle	SE,FE
Laterallus jamaicensis coturniculus	California black rail	SR
Pelecanus occidentalis californicus	California brown pelican	SE,FE
Rallus longirostris obsoletus	California clapper rail	SR
MAMMALS		
Reithrodontomys raviventris	Salt marsh harvest mouse	SE,FE

1/ SR = State listed rare species.
SE = State listed endangered species.
FE = Federally listed endangered species.

Table 75: Population in the North Bay Service Area
1980-2010
(thousands)

SWP Contractor	1980	1990	2000	2010
Napa County FCWCD	97.7	104.8	111.7	117.7
Solano County FCWCD	235.2	342.4	428.7	514.8
Total	332.9	447.2	540.4	632.5

Table 76: Water Supplies in the North Bay Service Area
1980 - 2010
(thousands of acre-feet)

Water Source	1980	1990	2000	2010
Local Ground Water	9.1	9.1	9.1	9.1
Local Surface Water	34.0	34.0	34.0	34.0
Waste Water	3.0	8.4	9.2	9.8
Solano Project	31.1	31.1	31.1	31.1
Interim Contract, Solano Project and Putah Creek	19.5	0	0	0
SWP, Full Entitlement	0	67.0	67.0	67.0
SWP, W/O Additional Facilities	0	[33.3]	[30.1]	[30.1]
Total, Full Entitlement	96.7	144.2	144.2	144.2
Total, w/o Additional Facilities	[96.7]	[110.5]	[107.3]	[107.3]

Source: Department of Water Resources, State Water Project; Recommended Water Management Plans: Napa County Flood Control and Water Conservation District and Solano Flood Control and Water Conservation District, 1982.

Brackets indicate reduced SWP deliveries.

Table 77: Water Demand in the North Bay Service Area
1980 - 2010
(thousands of acre-feet)

Water Demand	1980	1990	2000	2010
Urban Water Demand	77.6	98.2	118.1	137.8
Conservation (Urban)	-	(9.0)	(16.1)	(20.8)
Total	77.6	88.6	102.0	117.0

Source: Department of Water Resources, State Water Project; Recommended Water Management Plans: Napa County Flood Control and Water Conservation District and Solano Flood Control and Water Conservation District, 1982.

Parentheses indicate negative numbers.

Table 78: Average Annual Direct, Indirect, and Induced Income Impact Supported by SWP Firm Deliveries
North Bay Service Area
(billions of 1982$)

Impacts Between Scenarios	1980-1989		1990-1999		2000-2009		2010-2019		2020+	
	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced
Scenarios 1 and 2	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$0.1	$ 0.5
Scenarios 2 and 3	0	0	0	0	0	0	0	0	0	0
Scenarios 3 and 4	0	0	0	0	0	0	0.1	0.5	0.1	0.5
Scenarios 4 and 5	0	0	0	0	0	0	0.1	0.5	0.1	0.5
Total Impact	0	0	0	0	0	0	0.2	1.0	0.3	1.5

Table 79: Average Annual Direct, Indirect, and Induced Employment Impact Supported by SWP Firm Deliveries
North Bay Service Area
(thousands of person-years)

Impacts Between Scenarios	1980-1989		1990-1999		2000-2009		2010-2019		2020+	
	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced	Direct	Direct Indirect & Induced
Scenarios 1 and 2	0	0	0	0	0	0	0	0	1.3	10.7
Scenarios 2 and 3	0	0	0	0	0	0	0	0	1.2	9.8
Scenarios 3 and 4	0	0	0	0	0	0	1.2	9.8	1.4	11.5
Scenarios 4 and 5	0	0	0	0	0.6	5.0	1.2	9.9	1.4	11.6
Total Impact	0	0	0	0	0.6	5.0	2.4	19.7	5.3	43.6

Table 80: Average Annual Population Impact Supported by SWP Firm Deliveries
North Bay Service Area
(thousands of persons)

Impacts Between Scenarios	1980-1989	1990-1999	2000-2009	2010-2019	2020+
Scenarios 1 and 2	0	0	0	0	1.2
Scenarios 2 and 3	0	0	0	0	1.1
Scenarios 3 and 4	0	0	0	1.2	1.4
Scenarios 4 and 5	0	0	0.6	1.1	1.3
Total Impact	0	0	0.6	2.3	5.0

Table 81: Average Annual Housing Unit Impact Supported by SWP Firm Deliveries
North Bay Service Area
(thousands of units)

Impacts Between Scenarios	1980-1989			1990-1999			2000-2009		
	Total	Single Family	Multiple Family	Total	Single Family	Multiple Family	Total	Single Family	Multiple Family
Scenarios 1 and 2	0	0	0	0	0	0	0	0	0
Scenarios 2 and 3	0	0	0	0	0	0	0	0	0
Scenarios 3 and 4	0	0	0	0	0	0	0	0	0
Scenarios 4 and 5	0	0	0	0	0	0	0.2	0.2	0
Total Impact	0	0	0	0	0	0	0.2	0.2	0

Impacts Between Scenarios	2010-2019			2020+		
	Total	Single Family	Multiple Family	Total	Single Family	Multiple Family
Scenarios 1 and 2	0	0	0	0.5	0.4	0.1
Scenarios 2 and 3	0	0	0	0.5	0.4	0.1
Scenarios 3 and 4	0.5	0.3	0.2	0.6	0.4	0.2
Scenarios 4 and 5	0.5	0.4	0.1	0.5	0.4	0.1
Total Impact	1.0	0.7	0.3	2.1	1.6	0.5

Table 82: Total Projected Population, Housing Unit, and Acreage Requirements
North Bay Service Area

	1980	1990	2000	2010
Population				
(thousands of persons)	332.9	447.2	540.4	632.5
Housing Units				
(thousands of units)				
Single Family	108.1	156.2	194.2	227.6
Multiple Family	14.8	23.3	28.5	32.9
Total Housing	122.9	179.5	222.7	260.5
Acreage Requirements				
(thousands of acres)				
Single Family 1/	21.6	31.2	38.8	45.5
Multiple Family 2/	0.7	1.2	1.4	1.6
Total Acres	22.3	32.4	40.2	47.1

1/ Assumes 1 acre could accommodate 5 single family units.

2/ Assumes 1 acre could accommodate 20 multiple family units.

Table 83: SWP Impacts Above Historical Activity, North Bay Service Area[1/]

	1979-1983[2/] SWP Annual Average	1980-1989 Scenario 1	1980-1989 Scenario 4	1980-1989 Scenario 5	1990-1999 Scenario 1	1990-1999 Scenario 4	1990-1999 Scenario 5	2000-2009 Scenario 1	2000-2009 Scenario 4	2000-2009 Scenario 5
Population (thousands of persons)	0.7	0.5	0.5	0.5	2.8	2.8	2.8	3.7	3.7	3.1
Housing Units (thousands of units)										
Single Family	0.2	0.2	0.2	0.2	1.0	1.0	1.0	1.3	1.3	1.1
Multiple Family	0.1	0	0	0	0.2	0.2	0.2	0.2	0.2	0.2
TOTAL	0.3	0.2	0.2	0.2	1.2	1.2	1.2	1.5	1.5	1.3
Acreage Requirements (thousands of acres)										
Single Family[3/]	0.04	0.04	0.04	0.04	0.2	0.2	0.2	0.26	0.26	0.22
Multiple Family[4/]	0.005	0	0	0	0.01	0.01	0.01	0.01	0.1	0.01
TOTAL	0.045	0.04	0.04	0.04	0.21	0.21	0.21	0.27	0.27	0.23

1/ These impacts are the incremental changes in historical SWP activity caused by SWP scenario deliveries for each decade. Positive numbers represent an incremental increase in SWP historical activity (growth), while negative numbers (in parentheses) represent incremental decreases in SWP historical activity.

2/ These estimates are the total levels of socioeconomic activity affected by SWP average annual deliveries over the period 1979-1983.

3/ Assumes 1 acre could accommodate 5 single family units.

4/ Assumes 1 acre could accommodate 20 multiple family units.

Table 84: SWP Impacts As Percentage of Total Projected Service Area Increase, North Bay Service Area[1/]

	1980-1989			1990-1999			2000-2009		
	Scenario 1	Scenario 4	Scenario 5	Scenario 1	Scenario 4	Scenario 5	Scenario 1	Scenario 4	Scenario 5
Population	0.4%	0.4%	0.4%	1.3%	1.3%	1.3%	1.2%	1.2%	1.0%
Housing Units									
Single Family	0.4%	0.4%	0.4%	1.2%	1.2%	1.2%	1.1%	1.1%	0.9%
Multiple Family	0	0	0	1.5	1.5	1.5	1.1	1.1	1.1
OVERALL HOUSING	0.4	0.4	0.4	1.2	1.2	1.2	1.1	1.1	0.9
Acreage Requirements									
Single Family	0.4%	0.4%	0.4%	1.2%	1.2%	1.2%	1.1%	1.1%	0.9%
Multiple Family	0	0	0	1.4	1.4	1.4	1.1	1.1	1.1
OVERALL ACREAGE	0.4	0.4	0.4	1.2	1.2	1.2	1.1	1.1	0.9

1/ This compares the incremental percentag change in socioeconomic activity caused by SWP deliveries with the total incremental change projected in Table 24. Positive numbers represent an incremental percentage increase in SWP historical activity (growth), while negative numbers (in parentheses) represent incremental percentage decreases in SWP historical activity.

APPENDIXES

C-095272

CONTENTS

Appendix A - Tables

Appendix A - Figure

Appendix B - Figures

APPENDIX A. MUNICIPAL AND INDUSTRIAL IMPACTS: THEORY AND METHODOLOGY

This appendix explains the underlying theories and the methodologies used in deriving the municipal and industrial economic and social impacts of water supplies delivered to the SWP service areas.

Impact Definitions

Impacts are the differences in a region under "with" and "without" conditions. In the case of the socioeconomic impacts of water supply, the differences would be evident in the social and economic profile of an area under various water supply scenarios. For the purposes of the Service Area Impact Study, full entitlements of SWP supplies can be considered the "with" condition (this corresponds to Scenario 1). Any SWP water supply level below full entitlements can be considered a "without" condition (this corresponds to Scenarios 2 through 5).

The levels of socioeconomic activity affected by Scenario 1 (such as population) do not represent additional levels above official State and/or local agency forecasts. These other governmental forecasts generally assume that resources (including water) would be adequate to support the projections. Thus, the Scenario 1 levels of socioeconomic activity are embodied in these projections.

Scenarios 2 through 5 depict varying levels of SWP reductions. As such, they represent departures from conditions implicitly assumed in the other agency forecasts (in other words, supplies of water are now inadequate). If these reductions in SWP are not made up by other compensating actions (such as developing alternative water sources, increasing conservation above already-projected levels, or changing production technologies), then the differences between Scenario 1 and Scenarios 2 through 5 could be viewed as reductions in the overall forecasts. For example, if the difference between Scenarios 1 and 5 is 100,000 people for a particular service area at a certain time, and local agency projections had estimated a total population of 800,000 people for that area (assuming full supplies), then the estimate of 700,000 people could be used as an indicator of the reduced population levels with reduced SWP supplies, <u>if no other compensating actions are taken</u>. However, this reduction in population should be considered as a maximum impact, because, to some degree, other compensating actions would likely be taken, thereby reducing the impact.

Direct Economic Impacts

Economic impacts, which are indicators of changes in the economic well-being of a region, can be classified as output, income, and employment impacts.

Changes in the level of water deliveries may change the level and/or composition of a region's production. However, double counting would exaggerate the output impacts, if gross output were used to measure this changed population. Double counting occurs because gross output includes intermediate output, or, output that is used as an input to the production process of another industry. For example, the output from petroleum refining is used in part by the rubber products manufacturers. When these exchanges occur within the region, there is no net gain to the region as a whole.

Of more importance is the portion of output that is sold as final demand. Final demand is output that is used for purposes other than further production within the region. The sources of final demand are personal consumption expenditures, capital formation, government purchases, and exports.

For every dollar of output delivered to final demand, some portion of that dollar is returned to each of the production inputs as income. All forms of regional income are of interest, namely employee compensation, economic profit, capital consumption allowance, net interest, and indirect business taxes (this income is also known as the value added by primary inputs.) It is important to note that the incidence of impacts is not limited to the purchasers of water. Although firms may buy the water used in production, the regional population realizes an increase in income through more channels than simply through the firm owners' profits (such as through wages and returns to capital). Income impacts are reported in 1982 dollars.

As regional production increases, so too will the use of labor inputs (though not necessarily proportionately). Therefore, the employment impacts of water delivery are also of interest. This impact is reported in person-years, which is one full-time position lasting one year.

Direct, Indirect, and Induced Economic Impacts

The economic impacts described above occur as an immediate consequence of a change in water supplies; these are called direct impacts. For example, additional water supplies permit a farmer to increase cropped acreage. The direct result is an increase in the owner's profit, the size of the workforce, and the total wages earned in the operation.

Secondary, tertiary, and further repercussionary impacts also occur over time. An indirect income impact occurs when the original enterprise, which expands production because of the increased availability of water, purchases inputs from other industries. Using the example, to expand acreage, the farmer must purchase additional fertilizer, seed, pesticide, and, perhaps, equipment. Because of the increased demand for fertilizer, for instance, the primary inputs to the fertilizer industry will receive more income.[1/]

An induced income impact also occurs when the receipients of the direct income and indirect income spend their money on consumer goods. Again using the example, the farmer may spend the additional profit on a new sofa. Primary inputs employed in the sofa manufacturing industry then realize an increase in income due to the increased demand. These impacts continue to extend, in diminishing amounts, throughout the economy over time.

In reality, these linkages are quite complex. Usually (especially in the urban areas) the changed water supplies affect more than one user, and each user has different input requirements and different expenditure patterns.

Fortunately, the various linkages can be modeled by input-output (I/O) analysis. The Department has undertaken such an effort for the California economy, which is documented in Bulletin 210 (Measuring Economic Impacts--The Application of Input-Output Analysis to California Water Resource Problems, March 1980). The I/O solution techniques result in a Type II multiplier (direct, indirect, and induced impacts); by multiplying a direct impact by the appropriate multiplier, the total impact can be calculated. These multipliers are applicable to income and employment impacts. For example, if the direct employment impact is ten jobs and the Type II employment multiplier is 3.0, the total employment impact (including direct, indirect, and induced impacts) is 30 jobs. The indirect and induced impacts can be identified by subtracting the direct impacts from total impacts. In this example, the indirect and induced employment impact is 20 jobs.

Although the direct income (or employment) impact is associated with a particular industry in a particular area, total impacts (as used in this report) measure the income accruing across all sectors and the whole State. Thus, to say the direct, indirect, and induced income impact of water supply to agriculture in the Imperial Valley is $50,000, is not to say that agriculture

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1/ Wages paid by the farmer to workers employed on the expanded acreage have often been incorrectly called an indirect impact because they are a payment to an input. Wages are correctly included in the direct impact category because they are a primary input to the farm enterprise. Wages to employees in industries producing the farm's intermediate inputs are indirect impacts.

in the Imperial Valley realized a $50,000 increase in income. Rather, the total statewide income increased by $50,000.

At least some of the secondary impacts (as indirect and induced impacts are sometimes called) will occur in the service area that experienced the initial change in water supply and the initial direct impacts. The magnitude of the service area's secondary impacts depends on the degree of economic independence of the region. Southern California, with its diverse industrial mix, will retain much of the secondary impact of an altered water supply. The San Joaquin service area, on the other hand, with its heavy reliance on agriculture and food processing outside the region, would lose much of the secondary impacts to regions with which it trades.

For this report, secondary impacts are estimated on a statewide basis. Although service area secondary impacts are not presented, they can be approximated using the regional input/output model developed for DWR Bulletin 210. In that report, the regional breakdown is classified by hydrologic basin. Thus, the secondary hydrologic basin impacts for the basins encompassing the service areas can be directly estimated. To compute the service area's secondary impacts would require some assumptions concerning the proportion of the service area's socioeconomic activity in relation to that of the larger hydrologic basins.

Social Impacts

Analysis of economic impacts provides aggregate estimates of changes in income and employment; social impacts include changes in population and lifestyles. Impacts on population, number of households, and number and composition of dwelling units are indicators of changes in the social environment. Other social impacts, such as changes in the quality of life, can not easily be quantified.

Water Importation and Economic Growth

In the impact analysis, a crucial question that needs to be addressed is the effect of water importation upon economic and population growth in a region. Does water importation stimulate regional socioeconomic growth, or is the importation a response to growth?

Mathematically, it is possible to estimate the amount of socioeconomic activity supported by water deliveries. For example, average per capita water use in the Los Angeles Hydrologic Study Area (HSA) was about 0.21 acre-feet in 1980. This implies that approximately 210 persons could be supported by the addition of 1,000 acre-feet to the Los Angeles HSA water supply. However, this is merely an expression of a physical relationship and does not necessarily imply that the additional water supply will induce population growth.

In reality, several factors (such as economic incentives and environmental amenities) could affect a firm's and/or individual's decision to locate in a particular area. Therefore, it is important to determine which factors influence an individual's decision to choose a community in which to live and which factors affect a firm's decision to become established in a particular location. This information can then be used to help determine the extent to which the availability of water affects their decisions.

Locational Preferences of Individuals

Every individual acts both as a consumer (of goods and services) and as a producer (of labor services). Most people have some preference as to "consumer location", that is, where they would like to live and spend their income. Most also face the question of "producer location", that is, the best place to earn an income. Acting as consumers, people seek to settle where living is secure, inexpensive, and agreeable. As producers, they seek to locate where earnings will be large and assured and the working conditions pleasant. These consumer and producer motives often exert conflicting pulls on the individual.

In deciding upon the final location, producers' motives are much more significant than consumers' motives. Geographic differentials in wage rates or the profit prospects of particular occupations are larger and better known than differentials in living costs or conditions. Moreover, producers' motives are more compelling: whoever ignores them risks unemployment or bankruptcy. In addition, the less tangible consumers' motives are strongly shaped by habit and past association, rather than by regional amenities or economies.

Thus, of more importance are the location decisions of firms and individuals' decisions as producers of labor services. Consumers' motives are important only in that firms' locations are influenced by labor costs, which are partly determined by such considerations as cost-of-living differentials. However, some believe that economic considerations are becoming a less important part of a firm's decision on location; therefore, personal wishes and noneconomic factors related to community living and working environments are expected to rise in importance.[2/]

Location Decision-Making by Firms

Decisions on location by manufacturing establishments are, in the United States, almost always made by the private sec-

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2/ Management and Economic Research, Inc., Industrial Location as a Factor in Regional Economic Development, Washington, D.C., 1967, pp. 11-30.

tor, and generally on the basis of market and other economic factors. The number and definition of these factors vary in the literature from author to author. Virtually every list, however, includes the following considerations:

Markets	Raw materials
Labor	Power, fuels, and water
Transportation	Community characteristics (externalities)

Given that a firm's objective is to maximize profits, the relative impacts of the foregoing factors on a location decision depend on the weight of each factor in the firm's profit function. The profit function, in turn, depends on the type of industry; however, some attempts to generalize have been made in the following discussion.

The activity of any enterprise can be broken into three stages:

1. Procurement--the purchase and transfer of necessary supplies and materials to the production site.

2. Processing--the transformation of supplies and materials, via the employment of resources in an organized way, into (potentially) more valuable forms, such as goods and services.

3. Distribution--the sale and delivery of these goods and services.

Early studies in urban economics emphasized almost exclusively the role of transportation costs associated with the procurement and distribution processes in explaining a firm's location decision criteria (Alfred Weber, Theory of the Location of Industries, 1909). A simplifying assumption of this "least-cost" or "transport cost" school (as the theories came to be known) was a uniform and predetermined distribution of all regional characteristics, except transportation. Obviously, if one assumes that all the "universal" factors except transportation are constant over geographical areas, transportation costs must be of paramount importance.

Another related school of thought is the "market area" school, which emphasizes product demand theory. It contends that the assumed inverse relationship between the price of a good and the quantity of that good demanded is analogous to the inverse relationship between quantity demanded and the distance away from the point of manufacture (the farther away, the higher the transport costs, the higher the price of the finished goods, the less demanded of that good). The "market area" school is similar to the "transport costs" school with its emphasis on transport costs, but it implicitly assumes that the distribution costs of an enterprise outweigh any consideration of procurement and processing cost differences.

The most realistic description of location decisions is that espoused by the "marginal location" school. This school of thought contends that information deficiencies and the multiplicity of relevant variables make it impossible for a firm to identify the area of absolute least cost (or maximum profits). Instead, it is only possible to identify the zone in which profits change to losses, and losses to profits.

This school suggests that location decisions go through as many as three levels of analysis: the regional analysis, the community analysis, and the site analysis. While the same location factors are involved in all three, in any specific case they may vary widely in their relative importance and impact on the decision from one level of analysis to another.

For instance, the first step is generally to decide in what region of the country a new firm or branch of an existing firm is to be located. This requires a study of the size, nature, and geographical configuration and future prospects of regional markets. Once the region has been selected, the market factor declines in importance as alternative communities in the market to be served are studied. Now community facilities, land, transportation, and resource supplies become more important. Finally, at the site level of analysis, markets are no longer an important consideration. Access streets, the size of water and sewer mains, and the bearing strength of the soil emerge as major factors, along with the cost of alternative parcels of available land.

These distinctions are of particular relevance to this study. Historically, access to markets in which to sell goods and services was a significant consideration of firms seeking to locate in Southern California. Some of the early stimulants to economic growth in the region occurred as barriers to transportation were removed by the railroad. As population grew in the region, local markets were expanded, thereby stimulating further economic growth. Today, with significant improvements in transportation technology and the advent of electronic data management, the importance of market location has diminished in a firm's location decision process.

Instead, firms now pay considerable attention to the desirability of local communities. For example, firms are now concerned with the availability and cost of land and other resources, the supply of adequate and inexpensive housing for employees, and the presence of community facilities and services. Thus, the availability and cost of water supplies, among other things, is becoming more of a concern in the location decision-making process.

Evaluation of Growth-Inducing Impacts

The question of water importation's impact upon a complex urban economy such as that found in Southern California is difficult to answer. Historically, much of the stimulus to economic growth in the region appears to have been related to firms' access to markets in which to sell their goods and services. Also, people were probably attracted to the region by its economic prosperity and environmental amenities. Although it was necessary to construct several water projects during the region's economic growth periods, these projects seem to have been more of a response to economic growth than a cause.

However, according to the California Environmental Quality Act, a growth-inducing action is one that "...could foster economic or population growth, either directly or indirectly, in the surrounding environment. Included in this are projects which would remove obstacles to population growth...(and)...which may encourage and facilitate other activities that could significantly affect the environment, either individually or cumulatively." Using this definition, can water importation into a region be considered as growth-inducing? Although it is recognized that water, by itself, does not cause growth, the lack of this resource (if severe enough) may hinder growth. In light of departmental projections of impending water shortages in the SWP service areas (1990 and beyond), the growth-inducing impacts of proposed SWP projects must be evaluated. This evaluation is required for individual projects, as well as for the cumulative effect of the SWP as a complete water importation system.

A proposed project is determined to be growth-inducing by comparing the population impact of the project (or the SWP as a whole) in the service areas with forecasted total population in the service areas. Because the SWP has been in operation for several years, the analysis should compare the estimated population impact of the project (or the SWP) with the forecasted population increase in the service area from 1985 to 2020. Thus, the analysis will evaluate the project's (SWP's) contribution to population growth over this period.

Population impacts are derived from the project's (SWP's) effect on income and employment in the service areas. This effect is determined by utilizing the Department's input/output (I/O) model, which describes the relationship between industries in the State's economy and inputs (including water) necessary to produce the various products of those industries. Because some industries are relatively large water users (and therefore water-dependent), while others are not, the model automatically identifies the portion of the economy that responds directly to additional water supplies and, therefore, is growth-inducing. In effect, the extent to which additional water will contribute to growth in an area depends on the industrial mix. Although the model does not deal with population directly, it does provide a basis for estimating employment. By applying employment/population relationships, the population associated with additional water can be derived.

The impacts determined by using the I/O model may include an upward bias because the model does not include a specific determination of possible reductions in water use due to conservation and changes in technology that go beyond 1976 levels. In this regard, the growth-inducing impacts should be considered as maximum impacts.

Finally, The Metropolitan Water District of Southern California is losing approximately 650,000 acre-feet per year of Colorado River entitlement, beginning in the late 1980s, as a result of a Supreme Court decision. This replacement represents about 33 percent of the average annual SWP deliveries to this service area from 1990 to 2030; thus, it is assumed that 33 percent of the impact of the SWP (or individual SWP components) in this service area can be regarded as a continuation of current conditions. Therefore, discussions of growth-inducement should only focus upon the "remainder" of the SWP deliveries after adjusting for this replacement.

Study Methodology

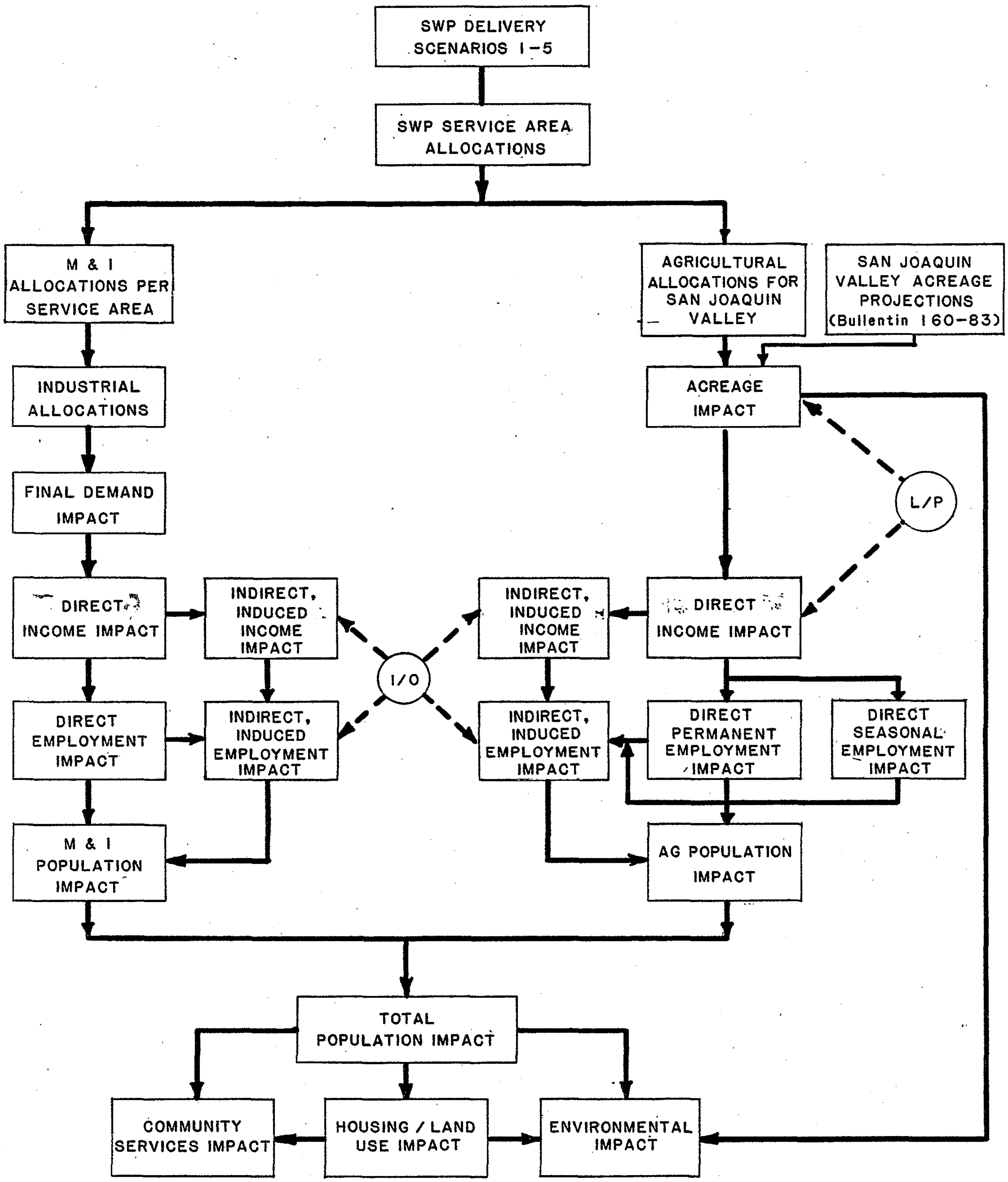
Figure A-1 presents the major steps used in this study to estimate the future economic, social, and environmental impacts of SWP deliveries to the service areas. The figure shows agricultural and M&I impacts; however, this appendix focuses only upon M&I impacts. An explanation of agricultural impact methodology is found in Appendix B.

Economic Impacts

The derivation of M&I impacts is based upon the premise that there exists some level of essential water supply that is necessary to maintain production and generate income; below this level, individuals and firms can no longer engage in compensating behavior that will leave their economic welfare unaffected. As more fully described below, this level of essential water supply is influenced by the sector of use (residential, commercial, industrial, or governmental), as well as by individual uses within the sector (processing, cooling, sanitation, etc.).

For example, changes in water supply that maintain the essential water supply will not have a significant effect upon M&I income because supplies above essential levels are used for such "non-income producing" activities as sanitation. However, changes in water supply that result in water supplies below the essential level will affect M&I income, because "income-producing" activities such as processing or cooling will have to be reduced.

Figure A-1: SERVICE AREA IMPACT STUDY FLOW CHART



L/P = DWR LINEAR PROGRAMMING MODEL (CVAg)
I/O = DWR INPUT/OUTPUT MODEL

C-095283

The procedure for determining M&I economic impacts requires the isolation of the portion of water supplies that will affect income (the essential supply). The income impact (per acre-foot) is then determined from water use and economic relationships, incorporating a set of crucial assumptions.

Income-Producing Sectors. After the M&I deliveries to the service area have been determined, it is necessary to identify the sectors that will be affected economically by the deliveries. This identification is based upon the following assumption:

Assumption 1: Water delivered to the commercial, governmental, and residential sectors does not create income directly.

This assumption is based on two considerations. First, most commercial and governmental water is not essential to the carrying on of these activities. Retail business would continue, for example, even if drinking fountains and public bathrooms were not available. Moderate changes in water supply to these sectors would affect only the quality of life.

The second consideration is that additional water supply to the governmental, commercial, and residential sectors will be used, at least partially, to satisfy the increased demand for their output arising from indirect and induced income impacts from the industrial sector.

This assumption does, however, exert a downward bias in the impact analysis, especially at extremely low water delivery levels (Scenarios 4 and 5, for instance). Severe water curtailment that eliminates many urban amenities would adversely affect worker productivity and property values. Future work may identify the water curtailment level at which quality of life aspects affect income, but currently it is unknown.

Given Assumption 1, the only M&I sector that may produce an income impact from changed water supply is the industrial (mining and manufacturing) sector. Because water use patterns, input mix, and market demand factors vary greatly by industry within this sector, income impacts are calculated on an industry-by-industry basis. Once that is completed, the importance of each of the industries to the specific region is examined to obtain an average regional impact value.

Industry-by-Industry Income Impacts. All changes in regional income occur because of an increased (decreased) ability to meet final demand caused by a relaxation (constriction) of a resource constraint. Increases or decreases in the demand for intermediate output of a particular firm causes shifts of income within the region only; thus there is no increase in income to the region as a whole. The following is assumed:

Assumption 2: The demand for additional production exists for each industry. Water supply is the only constraint to further production.

This is an extremely powerful assumption. It implies that (1) if water deliveries were curtailed, production would fall, and (2) if water deliveries were increased, production would increase. This is the same as saying that all industries are below the essential level of water delivery discussed earlier. This assumption introduces an upward bias to the impact values. The degree of bias depends on the industrial composition of the region, since the assumption is more realistic for some industries than for others. More correctly, the excess demand for industrial products and stringency of the water constraint would be determined on an industry-by-industry basis. However, the resources to undertake such a determination are not presently available.

An additional assumption is necessary before the numerical calculation of changes in final demand, and thus all the economic impacts, can proceed. That assumption is:

Assumption 3: Industry exhibits constant returns to scale and fixed input coefficient production functions.

In other words, water and other production inputs must be used in fixed proportions to create any level of output. An additional input supplied without the other corresponding inputs has a marginal product of zero.[3/] Further, to increase output by any multiple requires an increase in inputs by the same multiple. The proportions are assumed fixed according to those implied by the resource coefficients in DWR Bulletin 210.

The usefulness of this assumption is demonstrated in the subsections that follow, but the overall bias of the assumption can be generalized now. Ideally, the production function for each industry would be determined. If the function is normally behaved (that is, convex to the origin), the assumption of fixed input coefficients introduces an upward bias on the impact figure.

The validity of assuming constant returns to scale (CRS) is also dependent on the particular industry's production

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3/ This would be a fatal assumption in any study in which the value of water is investigated because the value in production equals the value of the marginal product. In this study, where impact (not value) is the objective, Assumption 3 is useful.

function. In general, CRS is valid for small changes in input and output levels. At high levels of input, decreasing returns are more likely; this implies that the impact value will be biased upward. At low levels of input use, increasing returns to scale are more likely; therefore, the impact value will be biased downward.

Final Demand Impacts. Table A-1 shows the development of changes in final demand for each of the industries in the first column (these industries use more than 1.0 percent of the industrial water in any of the SWP service areas).

Column (2) of Table A-1 is derived from the previously cited Bulletin 210. As part of that study, the total water use per million dollars of output produced for each industry is estimated on a statewide basis. By Assumption 3, the reciprocal of that resource coefficient expresses the value of output produceable by one acre-foot of water in combination with all other necessary inputs.

It is important to remember that column (2) is not the marginal product of water. By Assumption 2, all other necessary inputs such as labor are available to be combined with water in the fixed proportion noted in Bulletin 210. The resource coefficient reciprocal may be large, not because water has a large marginal product or contribution to production, but because water use is small, whereas the value of output is large. This curiosity is corrected later when the resulting impacts are multiplied by the appropriate share of water deliveries.

Column (3) defines the "necessary" level of water to a firm and embodies the following assumption:

Assumption 4: Only water delivered and used for actual production in manufacturing creates direct income.

DWR Bulletin 124-3, Water Use by Manufacturing Industries in California (May 1982), segregates industrial water use into water used for cooling, processing, and sanitary and miscellaneous uses. The sanitary and miscellaneous water includes the following applications: sanitary (employee washing, drinking, and personal hygiene); air conditioning; fire-suppression standby; esthetics; dust control; equipment washing; and other uses not involved in direct production. Increases or decreases in the level of these activities will affect the quality of the work environment but not output (except perhaps through effects on worker productivity, but these are assumed to be minimal).

Therefore, column (3) utilizes the proportion of industrial water use used for processing and cooling to define the productive water, thereby reducing the resource coefficient reciprocal to the potential output per acre-foot of productive water.

Table A-1
Changes in Final Demand[1/]
(1976 $)

(1) Industry	(2) Resource Coefficient Reciprocal[2/]	(3) Proportion for productive Use[3/]	(4) Potential Output/AF[4/] (1976 $)	(5) Final Demand Coefficient[5/]	(6) Final Demand/AF[6/] (1976 $)
Mining[7/]	12,743	1.000	12,743	0.011	136
Meat Products	158,301	0.938	148,486	0.804	119,383
Dairy Products	141,055	0.981	138,375	0.756	104,611
Canned and Frozen Foods	61,224	0.975	59,693	0.867	51,754
Grain Mill Products	309,044	0.930	287,410	0.417	119,850
Bakery Products	371,600	0.855	317,718	0.892	283,404
Sugar	22,802	0.996	22,711	0.200	4,542
Beverages and Flavorings	70,689	0.957	67,649	0.809	54,728
Misc. Food Products	127,991	0.980	125,431	0.660	82,784
Paper and Paperboard Products	16,630	0.994	16,530	0.251	4,149
Industrial Chemicals	49,999	0.994	49,699	0.089	4,423
Agricultural Chemicals	53,017	0.976	51,745	0.348	18,007
Gum and Wood Chemicals	183,035	0.972	177,910	0.278	49,459
Plastic Materials and Synthetic Fibers	69,570	0.923	64,213	0.006	385
Drugs	259,493	0.935	242,626	0.637	154,553
Cleaning and Toilet Preparations	184,684	0.966	178,405	0.815	145,400
Petroleum Refining and Related Products	77,456	0.998	77,301	0.534	41,279
Rubber and Plastics Products	341,667	0.864	295,200	0.217	64,058
Cement and Concrete Products	49,220	0.991	48,777	0.025	1,219
Misc. Stone and Clay Products	41,638	0.949	39,514	0.247	9,760
Blast Furnaces and Basic Steel Products	107,142	0.989	105,963	0.042	4,450
Iron and Steel Foundries and Forgings	135,911	0.900	122,320	0.031	3,792
Primary Nonferrous Metal Products	348,442	0.988	344,261	0.157	54,049
Cutlery, Hand Tools and General Hardware	401,960	0.866	348,097	0.393	136,802
Other Fabricated Metal Products	100,490	0.948	95,466	0.244	23,293
General Industrial Machinery	411,371	0.962	395,739	0.558	220,822
Computers and Office Equipment	506,173	0.618	312,815	0.881	275,590
Electrical Lighting and Wiring	488,095	0.930	453,928	0.338	153,428
Radio and T.V. Receiving Sets	347,458	0.682	236,966	0.925	219,194
Communication Equipment	938,932	0.732	687,298	0.848	582,829
Electronic Components	469,465	0.819	384,492	0.246	94,585
Aircraft	618,091	0.651	402,377	0.728	292,931
Ship and Boat Building and Repairing	141,868	0.946	134,207	0.882	118,371
Clocks and Scientific Equipment	872,340	0.818	713,574	0.692	493,793

1/ Figures in this table show the change in final demand per one acre-foot change in the water use of each industry.
2/ Bulletin 210, Measuring Economic Impacts, Table 17, column (3).
3/ Bulletin 124-3, Water Use by Manufacturing Industries in California, Table 4, pages 47-50.
4/ Column (2) x column (3).
5/ Bulletin 210, California Transactions Table, Appendix III; figure shown is equal to:

consumer expenditure + capital formation + government purchases + exports ÷ imports + gross output

6/ Column (4) x column (5).
7/ Because there is much less water use data for the mining sector than for manufacturing, all different mining activities (metal mining, crude petroleum, natural gas and stone and clay mining) have been combined here. The figures shown are based on a weighted average by total state use.

(A similar income impact would have resulted by reducing the water supply changes of the scenarios by the amount of "unproductive" water.)

This assumption introduces biases only in that the proportion used to represent productive uses was based on the statewide average technology for each industry. The technology of the regional industry may differ from the state average.

The potential output recorded in column (4) of Table A-1 includes output that is destined to intermediate use by other regional industries, as well as output consumed as final demand. As explained earlier, changes in resource constraints can affect regional income only if the ability to meet final demand is changed. Thus, potential output must be converted to final demand, using the final demand coefficient (the ratio of final demand to potential output) shown by industry in column (5). Again, some bias may be introduced by the utilization of state average coefficients.

Direct Income Impacts. For every dollar of output delivered to final demand, some portion of that dollar is returned to each of the production inputs. This report defines an income impact as that portion returned to the primary inputs in the way of employee compensation, economic profit, net interest, indirect business taxes, and capital consumption allowance.

Table A-2 presents the derivation of the direct income impacts. Column (2) contains the direct income coefficients for each of the industries; this coefficient represents the amount of direct income obtained per dollar of final demand. Multiplying this coefficient by the final demand impacts in Table A-1 (column 6) results in the direct income impacts, which are further separated into the components (columns 5-9, Table A-2). The direct income varies among industries because final demand (per acre-foot) by industry varies and because the fixed proportion of input usage varies among industries. As in Table A-1, the income impacts represent statewide averages for the indicated industries.

Direct Employment Impacts. For every dollar of output delivered to final demand, a number of person-years of employment is required. By Assumption 3, this ratio will be fixed for all levels of output. The statewide ratio by industry is shown in Table A-3. When the direct employment coefficient, as the ratio is called, is multiplied by the final demand change determined in Table A-1, the expected direct employment impact per acre-foot of water deliveries is found.

Regional Industrial Impacts. The impacts displayed in Tables A-1 to A-3 represent the change in final demand, direct income, and employment occurring because of an acre-foot change in water delivered to each industry, using statewide average data. This section transforms these industry-specific impacts into a number

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Table A-2
Changes in Direct Income 1/

(1) Industry	(2) Direct Income Coefficient 2/	(3) Direct Income 3/	(4) Wage Coefficient 4/	(5) Employee Compensation 5/	(6) Owner's value Added Coefficient 6/	(7) Owner's Value Added 7/	(8) Economic Profit Coefficient 8/	(9) Economic Profit 9/
Mining	0.56	76	0.289	22	0.618	47	0.395	30
Meat Products	0.11	13,132	0.573	7,525	0.280	3,677	0.178	2,337
Dairy Products	0.16	16,738	0.573	9,591	0.280	4,687	0.178	2,979
Canned and Frozen Foods	0.22	11,386	0.573	6,524	0.280	3,188	0.178	2,027
Grain Mill Products	0.17	20,375	0.573	11,675	0.280	5,705	0.178	3,627
Bakery Products	0.45	127,532	0.573	73,076	0.280	35,709	0.178	22,701
Sugar	0.21	954	0.573	547	0.280	267	0.178	170
Beverages and Flavorings	0.47	25,722	0.573	14,739	0.280	7,202	0.178	4,579
Misc. Food Products	0.17	14,073	0.573	8,064	0.280	3,940	0.178	2,505
Paper and Paperboard Products	0.36	1,494	0.661	988	0.312	466	0.181	270
Industrial Chemicals	0.32	1,415	0.585	828	0.386	546	0.210	297
Agricultural Chemicals	0.24	4,322	0.585	2,528	0.386	1,668	0.210	908
Gum and Wood Chemicals	0.29	14,343	0.585	8,391	0.386	5,536	0.210	3,012
Plastic Materials and Synthetic Fibers	0.27	104	0.585	61	0.386	40	0.210	22
Drugs	0.45	69,549	0.585	40,686	0.386	26,846	0.210	14,605
Cleaning and Toilet Preparations	0.22	31,988	0.585	18,713	0.386	12,347	0.210	6,717
Petroleum Refining and Related Products	0.24	9,907	0.449	4,448	0.089	882	-0.146	-1,446
Rubber and Plastics Products	0.39	24,983	0.735	18,363	0.174	4,347	0.081	2,024
Cement and Concrete Products	0.43	524	0.733	384	0.242	127	0.109	57
Misc. Stone and Clay Products	0.44	4,294	0.733	3,148	0.242	1,039	0.109	468
Blast Furnaces and Basic Steel Products	0.35	1,558	0.753	1,173	0.218	340	0.055	86
Iron and Steel Foundries and Forgings	0.40	1,517	0.753	1,142	0.218	331	0.055	83
Primary Nonferrous Metal Products	0.22	11,891	0.753	8,954	0.218	2,592	0.055	654
Cutlery, Hand Tools and General Hardware	0.47	64,297	0.769	49,444	0.206	13,245	0.137	8,809
Other Fabricated Metal Products	0.37	8,619	0.769	6,628	0.206	1,776	0.137	1,181
General Industrial Machinery	0.40	88,329	0.768	67,837	0.210	18,549	0.115	10,158
Computers and Office Equipment	0.37	101,968	0.768	78,311	0.210	21,413	0.115	11,726
Electrical Lighting and Wiring	0.50	76,714	0.768	58,916	0.210	16,110	0.108	8,285
Radio and T.V. Receiving Sets	0.33	72,334	0.768	55,553	0.210	15,190	0.108	7,812
Communication Equipment	0.55	320,556	0.768	246,187	0.210	67,314	0.108	34,620
Electronic Components	0.47	44,455	0.768	34,141	0.210	9,336	0.108	4,801
Aircraft	0.36	105,455	0.913	96,280	0.056	5,905	-0.033	-3,480
Ship and Boat Building and Repairing	0.43	50,899	0.913	46,471	0.056	2,850	-0.033	-1,680
Clocks and Scientific Equipment	0.45	222,206	0.807	179,320	0.173	38,442	0.098	21,776

1/ The figures in this table reflect the change in direct income per one acre-foot change in the water use of each particular industry. Note that employee compensation and owner's value added do not sum to direct income because of the exclusion of indirect taxes.

2/ Bulletin 210, Measuring Economic Impacts, Table 15, column (3), pages 96-99.

3/ Column (2) x Column (6) of Table A-1.

4/ Bulletin 210, California Transactions Table, Appendix III. These coefficients were derived by dividing total employee compensation by total gross output (which equals total outlays) for each industry.

5/ Column (3) x Column (4).

6/ Bulletin 210, California Transactions Table, Appendix III. These coefficients were derived by dividing the sum of economic profit, capital consumption allowance, and net interest by total gross output for each industry.

7/ Column (3) x Column (6).

8/ Bulletin 210, California Transactions Table, Appendix III. These coefficients were derived by dividing economic profit by total gross output for each industry.

9/ Column (3) x Column (8). Note that economic profit is a subset of owner's value added.

Table A-3
Changes in Employment per Acre-Foot 1/

(1) Industry	(2) Direct Employment Coefficient 2/	(3) Direct Employment 3/
Mining	6.74	0.923
Meat Products	7.19	0.858
Dairy Products	6.22	0.651
Canned and Frozen Foods	8.12	0.420
Grain Mill Products	5.55	0.665
Bakery Products	16.40	4.648
Sugar	5.49	0.025
Beverages and Flavorings	7.16	0.392
Misc. Food Products	7.79	0.645
Paper and Paperboard Products	12.98	0.054
Industrial Chemicals	4.85	0.021
Agricultural Chemicals	7.34	0.132
Gum and Wood Chemicals	9.16	0.453
Plastic Materials and Synthetic Fibers	8.90	0.003
Drugs	15.80	2.442
Cleaning and Toilet Preparations	8.86	1.288
Petroleum Refining and Related Products	2.32	0.096
Rubber and Plastics Products	17.98	1.152
Cement and Concrete Products	14.41	0.018
Misc. Stone and Clay Products	24.91	0.243
Blast Furnaces and Basic Steel Products	11.66	0.052
Iron and Steel Foundries and Forgings	20.97	0.080
Primary Nonferrous Metal Products	7.45	0.403
Cutlery, Hand Tools and General Hardware	25.37	3.471
Other Fabricated Metal Products	16.23	0.378
General Industrial Machinery	15.50	3.423
Computers and Office Equipment	22.45	6.187
Electrical Lighting and Wiring	25.28	3.879
Radio and T.V. Receiving Sets	24.71	5.416
Communication Equipment	21.83	12.723
Electronic Components	19.72	1.865
Aircraft	13.21	3.870
Ship and Boat Building and Repairing	21.13	2.501
Clocks and Scientific Equipment	24.43	12.063

1/ The figures in this table reflect the change in employment per one acre-foot change in the water use of each particular industry.

2/ Bulletin 210, Measuring Economic Impacts, Table 16, column (3).

3/ Column (2) x column (6) of Table A-1.

that represents the impact of a change of one acre-foot to the industrial sector as a whole within a region. This transformation is accomplished by the assumption:

> Assumption 5: Additions or deletions of water supplies are distributed among users in proportion to current use.

For example, the petroleum refining industry receives 18 percent of the current total Southern California manufacturing supplies. Therefore, under Assumption 5, the petroleum refining industry will receive 18 percent of any additional fresh water supplies and will cut water use by 18 percent, if supplies are reduced.

With such an assumption, the regional per acre-foot impact of industrial water can be expressed as the weighted average of the industry-by-industry impacts. This weighted average for a region is found by identifying the industries that are located in the region, and then weighting their impacts (Tables A-1 through A-3) by each industry's proportion of total mining and manufacturing water use. Table A-4 shows the weights and resulting impacts for the Southern California service area.

Regional M&I Impacts. The impact estimates for each sector of M&I use have now been defined. The income impact per acre-foot of industrial use in Southern California (for example) was found to be $24,745, in 1976 dollars (Table A-4, Column 6). By Assumption 1, the impacts per acre-foot of commercial, governmental, and residential uses are zero. From this information the income impact per acre-foot of M&I deliveries can be derived by use of the following assumption:

> Assumption 6: Additions or deletions to M&I water supplies are distributed among the manufacturing, commercial, governmental, and residential sectors in proportion to current use.

According to DWR Bulletin 160-83, The California Water Plan--Projected Use and Available Water Supples to 2010 (December 1983), within major urban areas, 63 percent of urban supplies are used in the residential sector; 11 percent, in commercial; 18 percent, in industrial; and 8 percent, in governmental. Therefore, if 82 percent of urban water is used in sectors where the marginal acre-foot yields an economic impact of zero and 18 percent is used in a sector where the marginal acre-foot yields an income impact of $24,745, then the overall impact of an acre-foot of urban deliveries in Southern California is $4,454 (1976 dollars). Similarly, the direct employment impact is 0.21 person-years per acre-foot of urban deliveries. These are summarized in Table A-5 for all the service areas (dollar impacts have been inflated to 1982 dollars in this table).

Table A-4
Economic Impacts per acre-foot in the Southern California Service Area[1/]
(1976 $)

(1) Industry	(2) Percent of Total Manufacturing Use[2/]	(3) Final Demand per AF of Use[3/]	(4) Wages per AF of Use[4/]	(5) Owner's Value Added per AF of Use[4/]	(6) Total Direct Income per AF of Use[4/]	(7) Direct Employment[5/]	(8) Type II Income Multiplier[6/]	(9) Type II Employment Multiplier
Mining	16.4	136	22	47	76	0.923	2.44	6.36
Meat Products	1.3	119,383	7,525	3,677	13,132	0.858	5.82	4.68
Canned and Frozen Foods	3.0	51,383	6,524	3,188	11,386	0.420	5.34	6.94
Bakery Products	2.3	283,404	73,076	35,709	127,532	4.648	2.71	3.15
Beverages and Flavorings	1.7	54,728	14,739	7,202	25,722	0.392	2.90	6.67
Misc. Food Products	6.1	82,784	8,064	3,940	14,073	0.645	4.51	4.57
Paper and Paperboard Products	4.5	4,149	988	466	1,494	0.054	3.30	3.87
Industrial Chemicals	2.0	4,423	828	546	1,415	0.021	3.73	8.10
Agricultural Chemicals	2.1	18,007	2,528	1,668	4,322	0.132	4.68	5.69
Gum and Wood Chemicals	1.9	49,459	8,391	5,536	14,343	0.453	3.84	4.73
Plastic Materials and Synthetic Fibers	1.8	385	61	40	104	0.003	3.96	4.64
Drugs	1.7	154,553	40,686	26,846	69,549	2.442	3.11	3.74
Cleaning and Toilet Preparations	1.3	145,400	18,713	12,347	31,988	1.288	5.30	5.76
Petroleum Refining and Related Products	18.4	41,279	4,448	882	9,907	0.096	4.64	14.19
Rubber and Plastics Products	1.5	64,058	18,363	4,347	24,983	1.152	3.10	3.09
Cement and Concrete Products	4.2	1,219	384	127	524	0.018	3.43	4.19
Misc. Stone and Clay Products	0.9	9,760	3,148	1,039	4,294	0.243	3.18	2.73
Blast Furnaces and Basic Steel Products	1.4	4,450	1,173	340	1,558	0.052	3.56	4.46
Primary Nonferrous Metal Products	1.4	54,049	8,954	2,592	11,891	0.403	4.45	5.70
Cutlery, Hand Tools and General Hardware	1.1	136,802	49,444	13,245	64,297	3.471	3.02	2.74
Other Fabricated Metal Products	2.7	23,293	6,628	1,776	8,619	0.378	3.40	3.48
Computers and Office Equipment	1.1	275,590	78,311	21,413	101,968	6.187	4.27	3.50
Electric Lighting and Wiring	0.8	153,428	58,916	16,110	76,714	3.879	2.87	2.72
Communication Equipment	1.6	582,829	246,187	67,314	320,556	12.723	3.06	3.42
Electronic Components	1.5	94,585	34,141	9,336	44,455	1.865	3.34	3.61
Aircraft	1.5	292,931	96,280	5,905	105,455	3.87	4.43	5.26
Clocks and Scientific Equipment	2.4	493,793	179,320	38,442	222,206	12.063	3.27	2.93
Total	86.6							
Weighted Average		64,947	17,534	5,214	24,745	1.176	3.40	5.99

1/ The figures in the rows of this table represent changes in economic indicators per acre-foot change in the water use of each particular industry. The weighted average, however, represents changes in economic indicators per one acre-foot change in manufacturing water use as a whole.

2/ Bulletin 124-3, Water Use by Manufacturing Industries in California 1979, unpublished expansion of Table 6 to the 3-digit SIC code level. Counties considered as included in the Southern California Service Area were: Los Angeles, Orange, Riverside, San Bernardino, San Diego and Ventura. Only industries using greater than one percent of the total manufacturing water use were considered.

3/ Table A-1.

4/ Table A-2.

5/ Table A-3.

6/ Bulletin 210, Measuring Economic Impacts, Table 15, column (7), pages 96-99.

7/ Bulletin 210, Table 16, column (7), pages 100-103.

Statewide Impacts. The direct income (and employment) impacts occurring in the service areas lead to indirect and induced income (and employment) impacts throughout the State's economy. The indirect and induced income (and employment) impacts are estimated by multiplying the direct income (and employment) impacts by the Type II multipliers found in the last two columns of Table A-4. This process yields the statewide total impact (direct impacts in the service area, plus indirect and induced statewide impacts).

The Type II income multiplier in the Southern California service area is 3.40 (Table A-4); thus the statewide total income impact from a one acre-foot change in M&I deliveries to Southern California is $26,598 in 1982 dollars ($7,823 x 3.40). Similarly, the Type II employment multiplier is 5.99; therefore, the statewide total employment impact is 1.26 person-years. These are shown in Table A-5.

Table A-5: M&I Economic Impacts per Acre-foot

Impact	Service Areas				
	Southern California	Central Coastal	San Joaquin Valley	South Bay	North Bay
Final Demand (1982$)	$20,589	$12,023	$4,662	$28,059	$17,754
Direct Income (1982$)	$ 7,823	$ 4,335	$1,161	$11,275	$ 6,402
Direct, Indirect, and Induced Income (1982$)	$26,598	$17,499	$4,804	$37,774	$24,905
Direct Employment (person-years)	0.212	0.182	0.114	0.310	0.127
Direct, Indirect, and Induced Employment (person-years)	1.267	1.204	0.770	1.221	1.045

Social Impacts

Changes in the economic well-being of a SWP service area brought about by various surface water deliveries will be accompanied by changes in the social environment. Social impacts include changes in population, numbers of households, the number and distribution of housing units, and social services. The economic impacts of income and employment can also be considered as changes in the social environment. Although some of these social impacts can not be quantified, they are important.

Population Impacts. In the section, "Water Importation and Economic Growth", earlier in this appendix, it was reported that water had an impact on personal location decisions, primarily through its effect on employment opportunities. Therefore, population impacts are determined by changes in employment.

The service area employment impact from which population impacts are derived includes direct, indirect, and induced employment effects; however, the Type II multiplier discussed previously estimates statewide secondary impacts. Thus, it is necessary to determine how much of the statewide secondary employment remains in the service area. (This depends on the degree of economic independence in the service area). An approximation of the service area secondary employment impacts can be derived, using the regional I/O model discussed in Bulletin 210. (The regions used in that report were hydrologic basins).

Table 23 of Bulletin 210 presents multi-regional direct, indirect, and induced income coefficients. Given a change in final demand in any one hydrologic basin, the resulting income changes for the other basins, and for the State as a whole, can be estimated.

By taking the ratio of a hydrologic basin's income coefficient to the statewide coefficient, an indication of the portion of the total statewide income impact that remains in the basin can be derived. It is assumed that this ratio of basin income to statewide income can also be applied to employment.

Thus, the amount of secondary employment that remains in the hydrologic basin can be estimated by applying the foregoing ratio to the statewide employment impacts. Because the service areas are smaller than the hydrologic basins, it is also necessary to estimate the service area's proportion of total employment to that of the hydrologic basin. This is accomplished by determining the current proportion of the service area's population to the hydrologic basin's population.

By multiplying an assumed population-per-employee ratio by the total employment impact for the service area, per acre-foot population impacts can be found. These are shown by service area to 2020 in Table A-6.

Because the population impacts are tied to employment impacts, the issue of unemployment becomes important. The creation of new jobs from the delivery of water supplies does not necessarily imply additional population growth because the additional jobs could be filled by the locally unemployed. Thus, the population impacts will contain an upward bias. The issue of unemployment is discussed in more detail later in this section.

Households and Housing Unit Impacts. Changes in population will affect the number of households and housing units. Table A-6

Table A-6
M&I Social Impacts per Acre-foot

Impact	1980	1990	2000	2010	2020
Southern California Service Area					
Population 1/	2.28	2.34	2.23	2.23	2.23
Households	0.84	0.90	0.86	0.86	0.86
Housing Units	0.86	0.96	0.91	0.91	0.91
Single Family 6/	0.53	0.58	0.53	0.53	0.53
Multiple Family	0.33	0.38	0.38	0.38	0.38
San Joaquin Valley Service Area					
Population 2/	0.20	0.20	0.20	0.20	0.20
Households	0.07	0.07	0.07	0.07	0.07
Housing Units	0.09	0.09	0.09	0.09	0.09
Single Family 6/	0.07	0.07	0.07	0.07	0.07
Multiple Family	0.02	0.02	0.02	0.02	0.02
Central Coastal Service Area					
Population 3/	0.70	0.63	0.59	0.59	0.59
Households	0.29	0.26	0.25	0.25	0.25
Housing Units	0.30	0.27	0.26	0.26	0.26
Single Family 6/	0.20	0.16	0.15	0.15	0.15
Multiple Family	0.10	0.11	0.11	0.11	0.11
South Bay Service Area					
Population 4/	0.13	0.13	0.13	0.13	0.13
Households	0.05	0.05	0.05	0.05	0.05
Housing Units	0.05	0.05	0.06	0.06	0.06
Single Family 6/	0.04	0.04	0.05	0.05	0.05
Multiple Family	0.01	0.01	0.01	0.01	0.01
North Bay Service Area					
Population 5/	0.12	0.12	0.12	0.12	0.12
Households	0.05	0.05	0.05	0.05	0.05
Housing Units	0.05	0.05	0.05	0.05	0.05
Single Family 6/	0.04	0.04	0.04	0.04	0.04
Multiple Family	0.01	0.01	0.01	0.01	0.01

1/ Based upon 84.4% of direct, indirect, and induced employment.
2/ Based upon 66.3% of direct, indirect, and induced employment.
3/ Based upon 26.7% of direct, indirect, and induced employment.
4/ Based upon 5.5% of direct, indirect, and induced employment.
5/ Based upon 3.9% of direct, indirect, and induced employment.
6/ Includes mobile homes.

displays projections of households and housing unit impacts per acre-foot. Because these impacts are derived from population impacts, an upward bias may be present.

Income Distribution Impacts. In addition to determining the magnitude of income changes in the community, it would also be desirable to estimate the incidence, or distribution, of that income impact within the population.

The wage impacts comprise the largest portion of total income changes (which is a continuation of current distributions). Table A-4 indicated that, in the Southern California service area, wage impacts were 71 percent of the direct income impact per acre-foot. The actual impact is less favorable to the wage earner when viewed on a per capita basis, however, because there are many more individuals to share the wage income than there are to share the profit income.

Unemployment Impacts. Employment statistics are often quoted as an indicator of the economic climate. However, because of the social values of having a job, employment and its converse, unemployment, can also indicate the social climate.

The economic impacts discussed in this report were based upon the premise that water supply does create jobs. These jobs can be filled in one of the following ways: immigration, use of unemployed workers, switching workers from part-time to full-time (reducing underemployment), and requiring overtime work of current employees. If a water supply increase is permanent, then the last source of labor (overtime) is not practical.

If there is an abundance of local people looking for work, firms will probably try to minimize the cost of the labor search by hiring from the regional labor pool. Thus, much of the impact of a change in water supply would reduce local unemployment and underemployment. However, if the unemployed labor pool does not contain the correct mix of job skills necessary to fill the new vacancies, local unemployment would not decrease; the new positions must be filled through immigration (causing population growth). Thus, there is a tradeoff between reducing local unemployment and increasing the population.

Social Services Impacts. The impact of increased water supplies upon social services in the service areas will be mixed. As indicated by this report, increased water supply levels will likely result in additional income and employment, both at the State and local levels. This increased economic activity could have a beneficial impact upon State revenues through the income and sales taxes, and a small portion of this could eventually filter down to the local agencies in the form of subventions. More important, the local agencies could receive revenue directly from property tax proceeds, which would likely increase, if there were additional population and housing.

However, additional socioeconomic activity can also place a strain upon local agencies because they must furnish more services (police and fire protection, schools, sewers, streets) for this population. Many communities have found growth to be a mixed blessing because the costs of providing services have frequently outstripped revenues. No attempt has been made to quantitatively estimate these impacts in this report.

APPENDIX B. AGRICULTURAL IMPACTS: THEORY AND METHODOLOGY

This appendix explains the underlying theories and methodologies used in deriving the agricultural economic impacts of SWP water deliveries to the San Joaquin Valley service area.[1/] The derivation of these agricultural impacts is outlined in Figure A-2 of Appendix A.

Direct Economic Impacts

Economic impacts, the economic consequences of a project or other action, can be classified as direct, indirect, or induced. Direct economic impacts are those effects that occur directly from the use of the project's output.

The Central Valley Agricultural (CVAg) linear programming (LP) model was used to derive direct income impacts of delivering various levels of SWP supplies for agricultural use in the San Joaquin Valley SWP service area. The CVAg model has been developed by the Department of Water Resources to forecast agricultural water demand for the Central Valley of California. The model's region of analysis is the Department's Detailed Analysis Unit (DAU), which in Kern and Kings Counties can encompass two or three water districts.

The advantage of the CVAg model is that it can select the optimal choice of inputs for the agricultural production process, based upon the assumption of maximum profit.[2/] Specifically, the model can analyze with relative ease the impacts of changing water availability and/or prices upon cropping patterns. As in all economic modeling studies, the model is based upon a set of assumptions.

One assumption provides that the "rational" grower will act to maximize profits. If a profit cannot be realized, then the grower will cease operation. Long-term profits may be maximized by short-term behavior that does not produce maximum profit, such as crop rotation, which involves producing crops with varying profitabilities in successive time periods.

Two other assumptions concern the technology used to produce the crops. First, for a given crop and DAU, constant

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1/ This is the only service area that uses SWP supplies extensively for agriculture.

2/ Linear programming models can be used to solve "maximization" problems, as in this case, or "minimization" problems (for example, minimization of costs).

returns to all inputs are assumed. Second, all producers of a crop in a DAU are assumed to use the same technology and the same combination of inputs and to obtain the same yields. The CVAg model also assumes that the fixed cost for a crop in a DAU can be expressed in per-acre terms and includes rent of land, improvements, equipment, long-term debt, taxes, payments for management and risk, and a level of profit deemed necessary to induce the producer to stay in business for an extended length of time.

Also considered in the CVAg model are market demands for crops, which are expressed as discrete forms of econometric estimations of the demand for Central Valley crops. Using demand functions (developed by Auslam and Associates), the model determines crop prices endogenously.

In essence, the CVAg model treats each DAU as though it were operated as a single profit-maximizing unit. This single unit would then produce that mix of crops which would maximize profits, subject to the constraints specified in the model.

Total acreage projections for the San Joaquin Valley obtained from Bulletin 160-83 were used to provide a base for the acreage impacts. Specifically, projections were obtained for DAUs that encompass the San Joaquin Valley SWP service area: 238, 241, 245, 246, 254, 255, 256, 258, 259 and 261 (Figure B-1). However, these DAUs include a larger area than that served by the contractors; therefore, a share analysis was used to determine the total number of acres irrigated by the contractors within these DAUs.

The CVAg model was then used to estimate for each scenario (and time period) the acreage changes for the DAUs. Contractors' changes, or impacts, were then estimated by a share analysis and subtracted from the base projections (Bulletin 160-83).

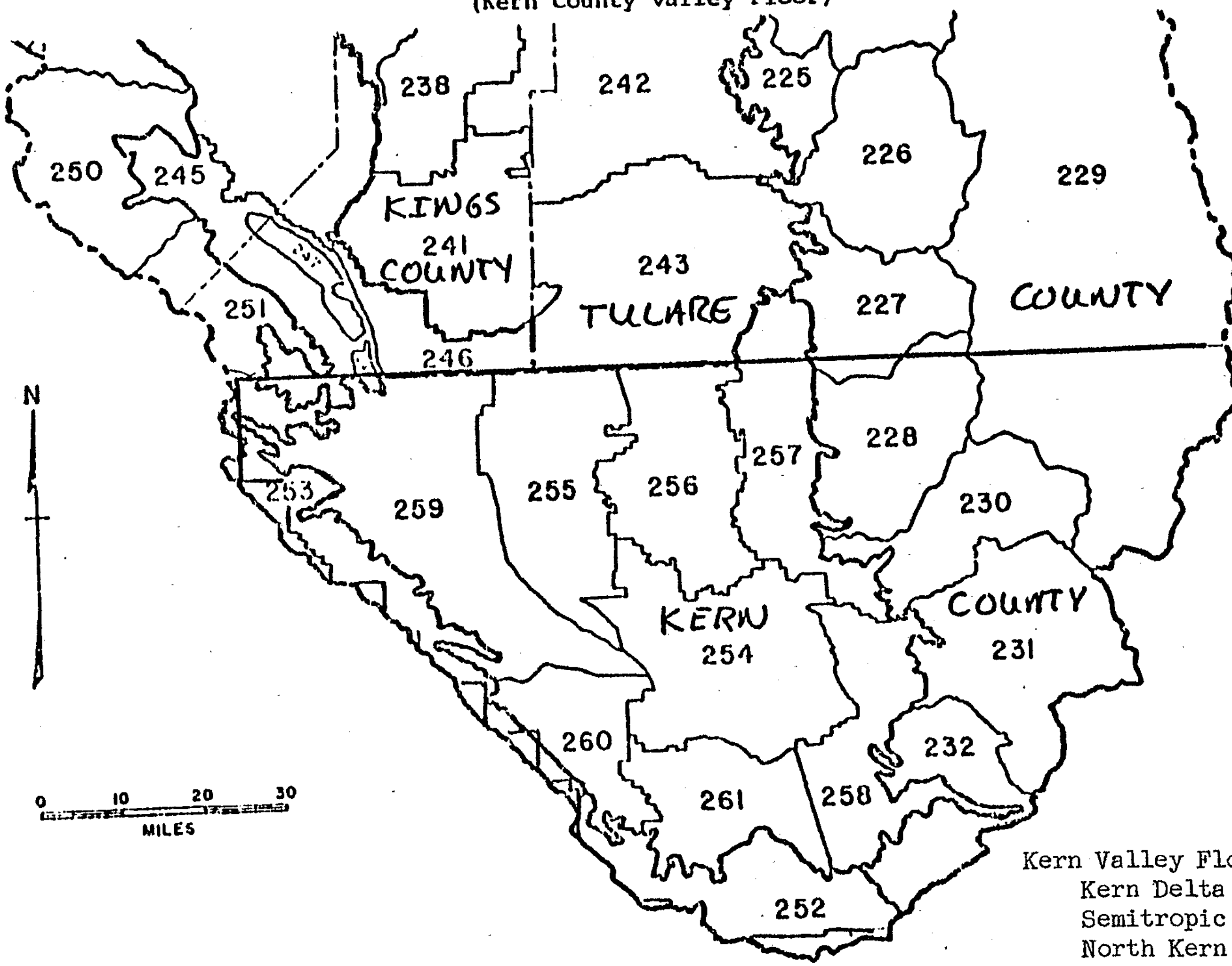
By combining crop budget and market demand data contained in the CVAg model with the estimates of the contractors' acreage, the direct monetary impacts of changing water supplies can be determined. These direct monetary impacts for the SWP contractors include the three major components of income: economic returns to the owners (revenue less costs), management returns, and returns to labor (wages). Direct agricultural employment impacts are estimated from average labor requirements per acre of irrigated land (both valley-wide and contractor). Agricultural employment is split between permanent and seasonal help.

However, no agricultural area in the State operates independently of the others. Changes in water supplies and costs in the San Joaquin Valley service area also affect the comparative advantage of other areas, and may therefore change the geographical distribution that was optimal under the previous conditions,

Figure B-1

DETAILED ANALYSIS UNITS OF THE
SAN JOAQUIN VALLEY

(Kern County Valley Floor)



Kern Valley Floor
Kern Delta (254)
Semitropic (255)
North Kern (256)
Northeastern Kern (257)
Arvin-Edison (258)
Antelope Plain (259)
Buena Vista Valley (260)
Wheeler Ridge-Maricopa (261)

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as well as the amount of each crop grown.[3/] Thus, direct economic impacts as a result of different SWP deliveries to the San Joaquin Valley service area (the scenario analysis) are also estimated for the entire Central Valley.

The possible effects of changing water availability on agricultural direct net income can be represented by using a graph similar to Figure B-2. The downward-sloping curve represents an area's demand for agricultural water. This demand can also be called the value of the marginal product curve because it shows the additional farm output valued at current prices that can be generated by applying an additional acre-foot of water to the farmland, holding other inputs constant. Each point on the demand curve represents the value of the marginal product of the most profitable combination of crops producible with the corresponding quantity of water.

The upward-sloping, discontinuous curve represents the supply of water schedule. The amount of surface water, including SWP and CVP supplies, is limited in any period. Because it is the least expensive of the agricultural water sources, it will be used first. Ground water is not legally constrained but experiences an increase in costs at some point because new, deeper wells must be built to overcome the fixed capacity of shallower wells.

Under base assumptions, farmers in an area will utilize the amount of water represented by Q* because that is the point at which the additional revenue from using an additional acre-foot of water just equals its additional cost. The consumer surplus realized by the farmer from utilizing this optimum level of water is represented by the shaded area.

The effects of increased SWP water supply on total water use are shown in Figures B-3 and B-4. As the amount of SWP water available increases, the total amount of surface water increases from SW to SW'.

In Figure B-3, the increase in SWP supplies causes no change in optimal total water use or cropping pattern. Increased surface water displaces an equal amount of ground water and the farmer's consumer surplus increases by the amount of the hatched area. Figure B-4 shows a different case in which an increase in SWP supplies causes a shift in the optimal water use level (from Q* to Q*'). The additional water will be used to irrigate new acreage or change existing acreage to more water-intensive and high-revenue crops. Again, the increase in consumer surplus

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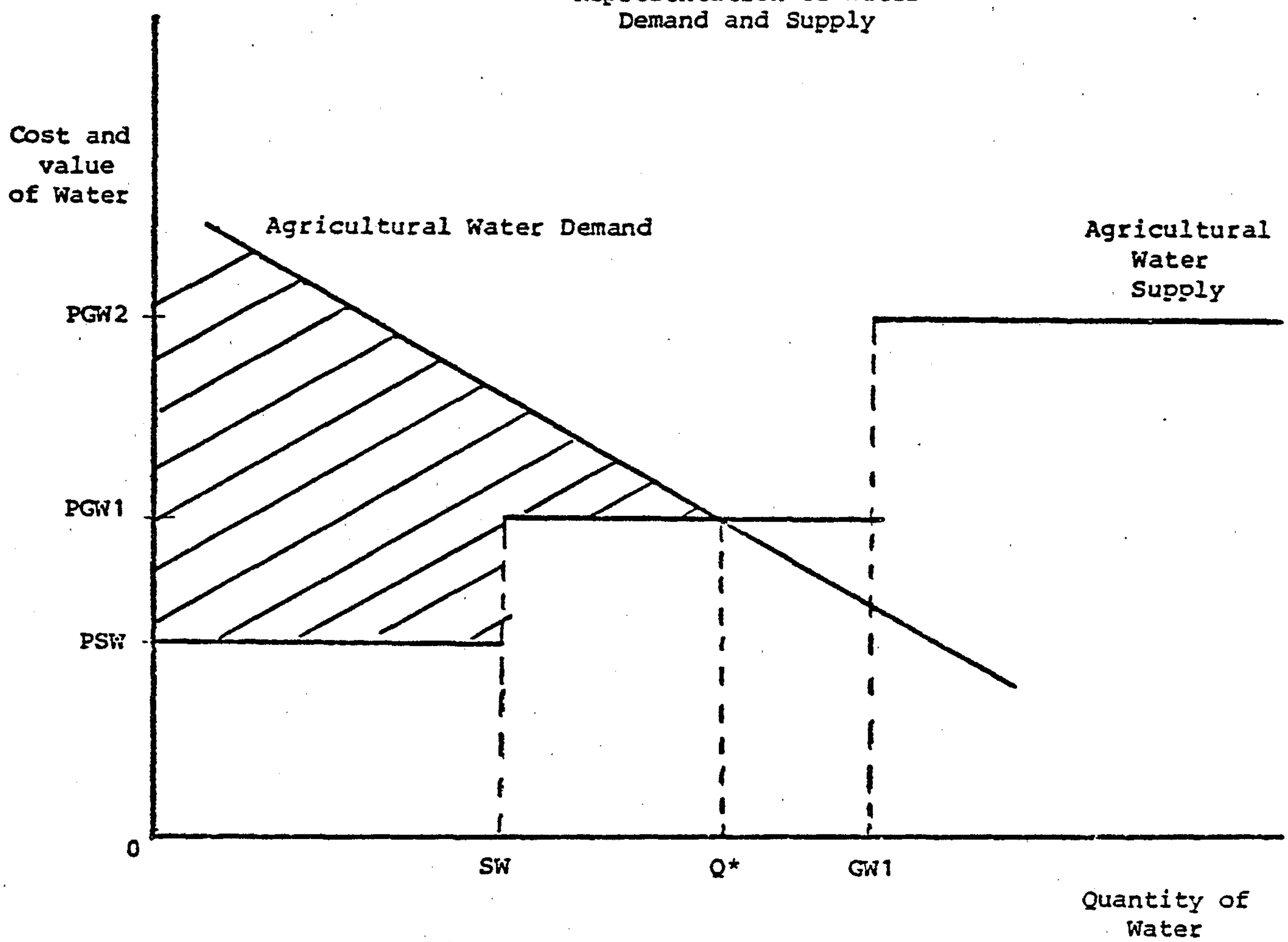
3/ Comparative advantage refers to the efficiency and profitability of growing a certain crop in one area as opposed to another area. Comparative advantage is related to differences in yield, input prices, and soil suitability.

Figure B-2

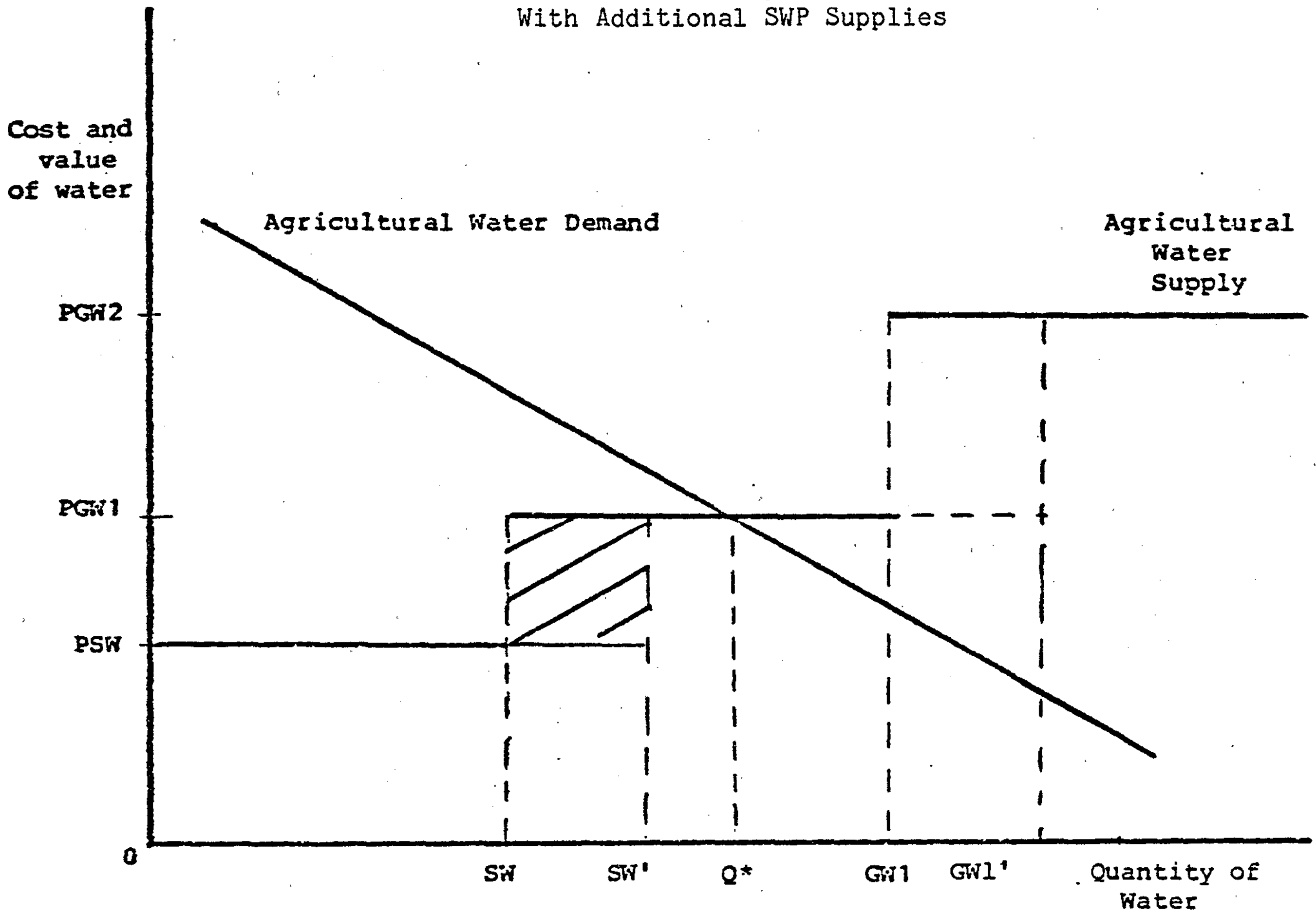
Representation of Water Demand and Supply



O-SW	:	surface water available, base case
SW-GW1	:	groundwater available with current pumping capacity, base case
PSW	:	price of surface water
PGW1	:	price of groundwater with present pumping system
PGW2	:	price of groundwater with augmented pumping system

Figure B-3

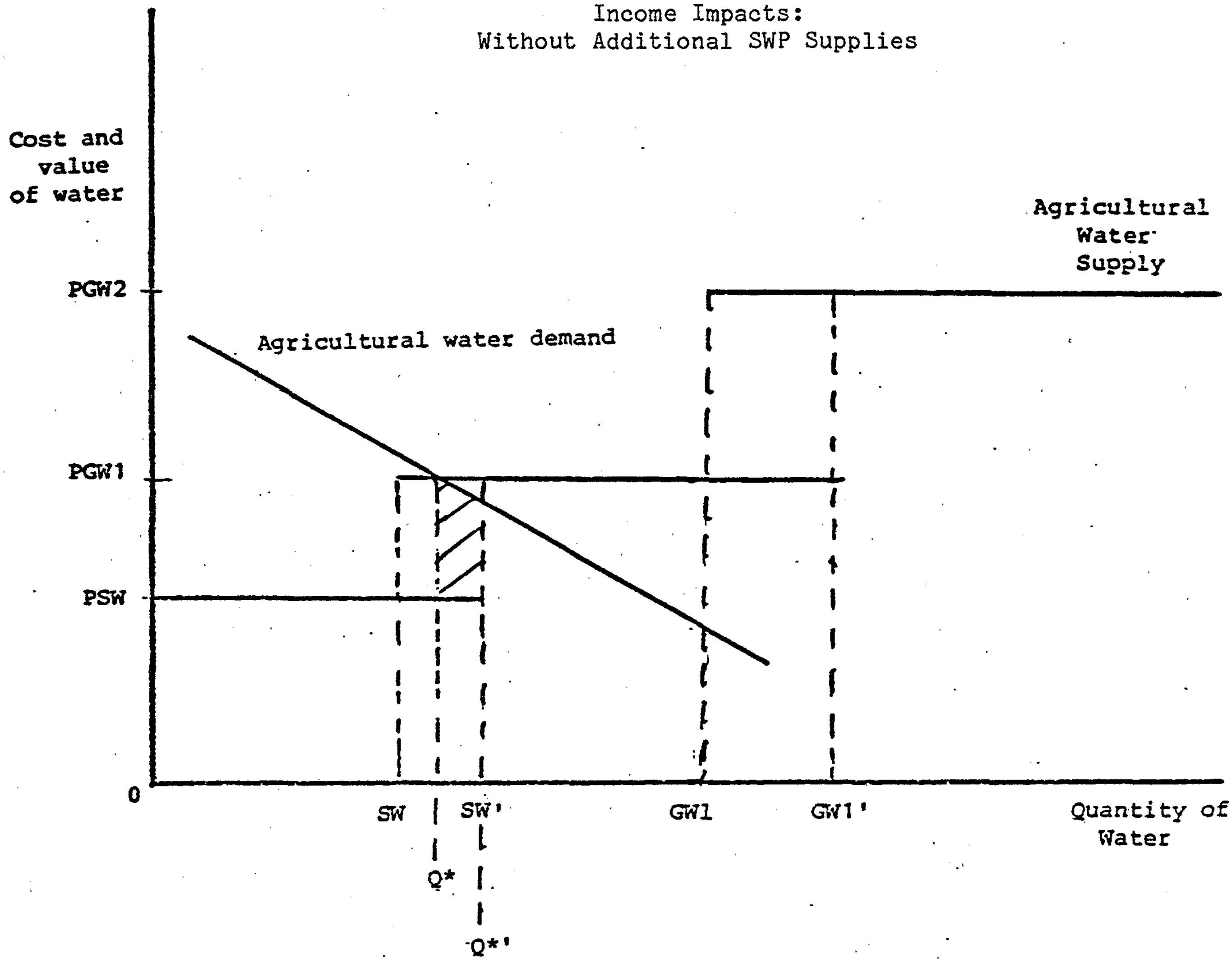
Representation of Net
Income Impacts:
With Additional SWP Supplies



O-SW : surface water available, base case
O-SW' : surface water available, with additional SWP supplies
SW-GW1 : groundwater available with current pumping capacity, base case
SW'-GW1' : groundwater available with current pumping capacity, with additional SWP supplies
PSW : price of surface water
PGW1 : price of groundwater with present pumping system
PGW2 : price of groundwater with augmented pumping system

Figure B-4

Representation of Net
Income Impacts:
Without Additional SWP Supplies



O-SW	:	surface water available, base case
O-SW'	:	surface water available, without additional SWP facilities
SW-GW1	:	groundwater available with current pumping capacity, base case
SW'-GW1	:	groundwater available with current pumping capacity, without additional SWP facilities
PSW	:	price of surface water
PGW1	:	price of groundwater with present pumping system
PGW2	:	price of groundwater with augmented pumping system

generated by the increased SWP supply is indicated by the shaded area.

The changes in consumer surplus shown in Figures B-3 and B-4 are equivalent to the change in economic profit accruing to the farmer, if all other input use levels were held constant. More realistically, and more consistent with the definition of economic impacts, the use of other inputs (land, labor, fertilizer, etc.) will not remain constant when water availability or costs change. Economic impacts should therefore include the change in economic profit, after adjustments in all inputs are complete, as well as the changes in regional income that occur because of increased labor and management utilization.

Figures B-3 and B-4 represent some typical area in the State. The demand curve is based on the value of crops and yields particular to the area. The quantity of water available from different sources, their prices, and the impacts of the speculated changes are also particular to the area.

Direct, Indirect, and Induced Economic Impacts

The direct income and employment impacts in the San Joaquin Valley service area and in the Central Valley as a whole will have repercussionary effects upon the local and State economies. The direct, indirect, and induced impacts are estimated using multipliers derived from DWR's input/output (I/O) model (Bulletin 210). Because direct changes in the contractors' service areas will affect agricultural areas throughout the State, direct, indirect, and induced impacts are estimated as a result of the Central Valley direct impacts, not solely the San Joaquin Valley service area direct impacts.